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American Society for Testing Materials

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NEWS ABOUT THE SOCIETY AND ITS COMMITTEES:

MISCELLANEOUS TECHNICAL NOTES AND NEWS:

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No. 139

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ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

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R. J. Painter, Associate Editor

Number 139 March 1946

Forty-ninth Annual Meeting in Buffalo—June 24 to 28, 1946

Very Strong Technical Program; Apparatus and Photographic Exhibits; Numerous Meeting Features

NOT only will the Society's Forty-ninth Annual Meeting, being held in Buffalo, N. Y., throughout the week beginning June 24, have one of the 'strongest' technical programs yet developed by the Society, but it will include as two very interesting features an Exhibit of Testing Apparatus and Related Equipment and a Photographic Exhibit which will include sections covering work on photomicrography and radiography. During the week there will be in progress a large number of meetings of A.S.T.M. technical committees. Thus a very intensive period of activity is in store for committee members in particular, but in fact for all those who will attend this meeting and it is confidently expected that the attendance will be quite high.

All meeting sessions, the exhibits, and other meeting features will take place in the Hotel Statler, but a number of other hotels are cooperating through the Buffalo A.S.T.M. Housing Bureau to take care of the member's room accommodations.

A special Buffalo Committee on Arrangements for the Annual Meeting is cooperating intensively in connection with several meeting activities. Reference is made below to the personnel of this group and to some of the plans it is developing.

Technical Program

Some idea of the diversity of the technical program can be noted from an advance outline of the schedule which appears on page 7 of this BULLETIN. Some minor changes may be made,[1] but it is not expected that there will be any major shift in the main sessions. Several of the newer activities of the Society are represented in some of the special sessions including the Symposium on Testing of Parts and Assemblies. This latter is under the joint auspices of the Society for Experimental Stress Analysis and A.S.T.M.

It will be noted that a Symposium on Bearings is scheduled for Monday, June 24, but otherwise Monday will be reserved for the meetings of many of the technical committees. Throughout the entire week many of the committees will be convening, usually scheduling their meetings to precede by a day or two the sessions at which the reports will be presented.

An innovation in the meeting this year will be the development of a few sessions devoted entirely to the presentation of committee reports. It is believed this procedure is worth a real trial and thus the sessions involving papers and symposiums can be concentrated on the particular topics and the committee reports involving Society business can be handled in sessions specifically designed for these actions.

[1] Some have already been made with two sessions added. Compare the table on page 7, with the one sent to members by mail.

President's Address; Dinner; Marburg Lecture

Since the Buffalo Committee has been very anxious to arrange an outstanding dinner meeting for Wednesday night, June 26, President Townsend has agreed to give his Annual Address at this meeting and associated with him in the program will be another outstanding speaker who is now being secured by the Buffalo Committee. Mr. Townsend, who has visited many of the Districts this year, addressing several on the topic "Research Revolutionizes Materials," plans to incorporate in his address a number of the experiences and conclusions from them which he has had in his years of intensive activity at Bell Telephone Laboratories where he is now Materials Engineer. The address is expected to be a down to earth discussion covering certain industrial and quasi-industrial problems involving technical men and engineers.

It will be noted that Wednesday, June 26, is a particularly full day, to be featured in the late afternoon by the presentation of the annual Marburg Lecture. This year the topic "Protective Organic Coatings as Engineering Materials" is to be covered by Dr. J. J. Mattiello, Vice-President of the Hilo Varnish Co. and one of the most widely known men in this field. Constantly in demand as a speaker, Dr. Mattiello has written numerous technical papers and has prepared a number of authoritative

books widely used in the industry. More information about his activities will appear in the May BULLETIN and this will include also some notes on the lecture. Dr. Mattiello has been in touch recently with other leaders in this field and a most authoritative, comprehensive lecture is assured.

A few notes on some of the details of the technical program appeared in the January BULLETIN and a complete provisional program, including synopses of many of the papers in the symposiums and sessions, will be published in the May BULLETIN. *Members are urged to be on the watch for this.*

HOTEL RESERVATIONS

There has been distributed to each member of the Society, and to committee members, a Hotel Reservation Form by which members could apply directly to the A.S.T.M. Housing Bureau in Buffalo for accommodations. *Each member is urged to return this form or to write at his earliest convenience.* Although it is not expected there will be much difficulty in meeting the requirements of our members, it is important that the Housing Bureau be advised as promptly as possible of the members' needs. The hotel return form asks members to indicate the hotel of first, second, and third choice and any details on the accommodations desired. It is expected that the policy in connection with the Pittsburgh meetings may again be followed of asking members to double up by using twin-bedded rooms. With few exceptions this practice worked out very well.

PREPRINTS OF REPORTS AND PAPERS

Each member in good standing will receive sometime in May a Preprint Request Blank which will enable him to indicate those technical papers or reports that he would like to obtain. An earnest effort is made to get as many as possible of the items on the program printed and distributed in advance and this is the case particularly in connection with the reports of the technical committees.

BUFFALO COMMITTEE ON ARRANGEMENTS

A Buffalo Committee on Arrangements for the Annual Meeting has been organized which will consist of the entire membership of the Western New York - Ontario District Committee plus a number of other interested members in the Buffalo area. The complete personnel of this group will be published in the May BULLETIN. Meanwhile there is a list below of the various subcommittees that have been organized with the chairmen. Several of these groups have held meetings and their plans are well under way. (See later pages for information on the exhibits.)

It had been expected that B. L. McCarthy, Chairman of the District Commitee, would serve as Chairman of the Buffalo Committee on Arrangements and he is being listed in this capacity. However, his extremely serious illness resulting from protracted grippe and pneumonia plus two serious operations makes it extremely unlikely that he can function actively on meeting plans, but before he became seriously ill he had developed matters to the stage where they will carry along in excellent shape, and T. L. Mayer, Secretary of the District, who is Vice-Chairman of the Local Committee will serve as Acting Chairman. Mr. Mayer has been correlating the various matters and his wide experience in connection with meetings as a Past President of the Engineering Society of Buffalo and his work in the Buffalo Public Library give him an excellent background for directing the local arrangements.

GENERAL COMMITTEE.—
B. L. MCCARTHY, Wickwire Division, Colorado Fuel and Iron Corp., *Chairman*
T. L. MAYER, Buffalo Public Library, *Vice-Chairman and Acting Chairman*

DINNER AND PROGRAM COMMITTEE.—W. H. Lutz, Pratt and Lambert, Inc., *Chairman*

APPARATUS EXHIBIT.—D. D. Crandell, National Gypsum Co., *Chairman*

PHOTOGRAPHIC COMMITTEE.—F. L. Koethen, Enterprise Oil Co., *Chairman*

PLANT VISITATION, TRIPS, ETC.—J. Gentile, Pittsburgh Testing Laboratory, *Chairman*

LADIES ENTERTAINMENT.—Mrs. D. D. Crandell, *Chairman*

GOLF TOURNAMENT.—C. M. Little, American Brass Co. *Chairman*

ENTERTAINMENT AND SPECIAL FEATURES

The Buffalo Committee on Arrangements is planning that this shall be a very full and complete meeting with respect to entertainment matters, and although A.S.T.M. Annual Meetings have never featured such matters to the detriment of the technical program or the exhibit or committee meetings, the

annual golf tournament, industrial trips, and various events planned for the ladies have always been very favorably received and add a great deal to the enjoyment of the members throughout the week. It will be seen that a Golf Committee is being organized. Further details will be sent to all the members but this advance note will advise those whose clubs have been on the rusty side to get out the necessary sand paper or steel wool or perhaps even do a bit of swinging before the week of June 24.

Buffalo has excellent representation of large companies in many leading industries and the committee on industrial trips will have several possibilities lined up for those members who wish to participate.

Concerning ladies' entertainment, while the committee headed by Mrs. Crandell is not prepared to make any formal announcement as yet, consideration has been given to an interesting trip on the Canadian side of the river from Lake Erie to Lake Ontario, with probably a stop at the General Brock Hotel for lunch or bridge and a visit to the famed gardens there. Of course Niagara Falls would be included somewhere in the plans and in addition there are a number of other interesting places in Buffalo appropriate for a bridge party or some other function.

SUBJECT TO CHANGE

ADVANCE OUTLINE OF ANNUAL MEETING SESSIONS

Buffalo, N. Y.—June 24–28, 1946

Monday morning and afternoon have been set aside for committee meetings only. Committee meetings will also be held throughout the week.

	MORNING	AFTERNOON	EVENING
Monday June 24	Committee Meetings	Committee Meetings	1. Symposium on Bearings
Tuesday June 25	2. Symposium on Fatigue 3. Symposium on Spectroscopic Light Sources	4. Symposium on Fatigue (Continued) 5. Symposium on Spectroscopic Light Sources (Continued)	6. Technical Papers on General Testing Methods
Wednesday June 26	7. Symposium on Testing Parts and Assemblies 8. Technical Papers on Cement and Concrete 9. Symposium on Oil Procurement Practices	10. Symposium on Testing Parts and Assemblies(Continued) 11. Presentation of Report of Comm. D-2. Symposium on Oil Procurement Practices (Cont.) 12. "Protective Organic Coatings as Engineering Materials" —J. J. Mattiello (Marburg Lecture)	Annual Dinner President's Address
Thursday June 27	13. Session on Effect of Temperature on the Properties of Metals —Materials for Gas Turbines 14. Symposium on pH Measurements	15. Symposium on pH Measurements (Continued) 16. Presentation of Reports of Committees A-1 to A-10, D-1, E-2 to E-7	17. Session on Effect of Temperature on the Properties of Metals —General (Cont.) 18. Symposium on Atmospheric Resistance of Stainless Steels 19. Discussion on Test Methods for Freezing and Thawing Concrete
Friday June 28	20. Presentation of Reports of Committees C-1 to C-18, D-4 and D-8 21. Presentation of Reports of Committees B-1 to B-9, D-3, D-5 to D-7, D-9 to D-20	22. Technical Papers on Plastics and Wood 23. Technical Papers on Non-Ferrous Metals	

Seventh Exhibit of Testing Apparatus and Related Equipment Will Be of Widespread Interest

Hotel Statler, Buffalo, June 24 to 28, inclusive

Two events which have featured several of the annual meetings will be renewed this year, namely, the Exhibit of Testing Apparatus and Related Equipment, and a Photographic Exhibit including sections on photomicrography and radiography. A separate article gives some additional information on the Photographic Exhibit.

Many of the country's leading manufacturers and distributors of testing and scientific instruments, laboratory supplies, and various materials used in investigations and testing and research of materials will participate in the commercial section of the Exhibit. In addition, several A.S.T.M. committees will sponsor research displays featuring some portions of their work, and it is expected there will be other displays sponsored by organizations in the Buffalo area covering subjects of interest to the large number of members, committee members, and visitors expected to attend the Exhibit. A number of the noncommercial exhibits are being developed by a local exhibit committee functioning under the Buffalo Committee on Arrangements, the subcommittee being headed by D. D. Crandell, National Gypsum Co.

Although it had been hoped to renew the Exhibit of Testing Apparatus and Equipment in 1945 after an interval of four years (1941), the continuation of the war and the transportation crisis forced a streamlined business meeting instead of the regular annual meeting and brought about postponement of the Exhibit until this year.

These exhibits, which have been sponsored biennially began at the 1931 meeting, and they have been growing in extent and interest. It was felt that an Exhibit, if properly organized, could stress many of the technical and scientific phases of the instruments and laboratory supply field and thus would be a very desirable adjunct to the annual meeting

Advance List of Commercial Exhibitors in 1946 ASTM Exhibit

Acme Industrial Co.
American Cystoscope Makers, Inc.
American Instrument Co.
American Optical Co.
Angel & Co., H. Reeve
Atlas Electric Devices Co.
Baldwin-Southwark Division, Baldwin Locomotive Works
Bowen and Co., Inc.
Buehler, Ltd.
Burrell Technical Supply Co.
Canadian Radium & Uranium Corp.
Central Scientific Co.
The Comtor Co.
Harry W. Dietert Co.
Eastman Kodak Co.
Elgin National Watch Co.
Engineering Labs., Inc.
Gamma Instrument Co.
General Electric Co.
General Radio Co.
Hanovia Chemical and Mfg.Co.
Kewaunee Mfg. Co.
Kimble Glass Co.
Krouse Testing Machine Co.
Macbeth Corp.
Magnaflux Corp.
Mueller Mfg. Co.
National Research Corp.
North American Philips Co.
Tinius Olsen Testing Machine Co.
Parr Instrument Co.
Picker X-ray Corp.
Precision Scientific Co.
Radium Chemical Co., Inc.
Rainhart Co.
Riehle Testing division, American Machine and Metals, Inc.
Scott Testers, Inc.
Sperry Products, Inc.
Standard Electric Time Co.
Statham Laboratories
Superior Electric Co.
Tagliabue Div. of Portable Products Corp.
W. M. Welch Manufacturing Co.
Westinghouse Electric Corp.
Will Corp.
Wilson Mechanical Instrument Co.

since instrumentation plays such an important part in the testing and evaluation of materials, and in developing authoritative data on properties and tests of materials, through research. The Exhibits have justified themselves on this phase alone and of course there is afforded an opportunity for our members and committee people to see in one convenient location a great number of the newer instruments, and improvements in older equipment and apparatus.

Many developments have been accelerated during the war years and consequently the Seventh Exhibit to be held throughout the week of the Annual Meeting at the Hotel Statler is awaited with much interest.

The Exhibit indicates the great extent and diversity of the apparatus and laboratory supplies industry. The volume of business in the testing machines field alone is rather startling when compared to ten and fifteen years ago, and when we add to this the metalware, glassware, and the other instruments and supplies which are widely used in the production and testing of all kinds of materials and products, we have indeed a most imposing industry.

A list of the commercial exhibitors who have thus far signified their intention of participating follows:

The Exhibit is to be held on the Seventeenth Floor of the Statler (where the Photographic Exhibit also will be housed) and thus it is readily accessible for all of those who will be attending the Annual Meeting since a number of the general sessions as well as committee meetings will be held on this floor. Further details will be given in the May BULLETIN.

1946 Photographic Exhibit at Annual Meeting in Buffalo

Sections on Radiography and Photomicrography

COMPLETE details of the 1946 Photographic Exhibit to be held during the Society's Forty-ninth Annual Meeting in Buffalo at the Hotel Statler, June 24 to 28, inclusive, have been sent to the members through a special folder and entry form. A copy of this went to each member and A.S.T.M. committee member. The Photographic Committee, headed by F. L. Koethen, Enterprise Oil Co., has selected for this year's theme, "Materials, Testing and Research." Photographs featuring apparatus, instruments, testing, and related items are especially desired. Photographs showing unique or unusual applications of materials are welcome; also those featuring the human element or personal factors.

Cognizant of the very intensive interest in the work on photomicrography, including particularly the metallographic field but also including electron microscopy, and in the field of radiographic testing, the committee has arranged for special sections to be devoted to these. Representation from Committee E-4 on Metallography and E-7 on Radiographic Testing has been arranged foron the Photographic Committee, thus tying in closely with these A.S.T.M. technical groups. The Committee is soliciting entries in the following classifications:

(a) Black and white or monochrome prints
(b) Color prints
(c) 2 by 2-in. color transparencies
(d) Photomicrographs
(e) Radiographs (Noncompetitive)

Full details of submitting entries, mounting and identification are given in the exhibit entry form and there are special details covering material in the photomicrographic and radiographic sections. Photographs are solicited from A.S.T.M. members or employees of member companies, and professional classes are established as well as the nonprofessional groupings.

A number of photographic exhibits have been held in previous years during Annual Meeting week, and all of them have been enthusiastically received. Many A.S.T.M. members do excellent photographic work and it is surprising how many enthusiasts are active in A.S.T.M. work.

The Photographic Committee is anxious that everyone interested shall participate in the exhibit, and those who are planning to submit entries are urged to get their return forms in promptly and to plan well ahead so that the photographs and the material in the sections on photomicrography and radiography can be received in Buffalo well in advance of the last date for receipt of entries which has been specified as June 17.

Sessions on Quality Control and on Corrosion of Non-Ferrous Metals Feature 1946 Spring Meeting

Much Interest in Simon and Manuele–Goffman Papers

THREE interesting technical sessions featured the 1946 A.S.T.M. Spring Meeting held in Pittsburgh on February 26 and 27. Two of the sessions comprised the Symposium on Atmospheric Exposure Tests on Non-Ferrous Metals, with six technical papers. The largest audience, however, about 350 members and visitors, was present at the session on Statistical Quality Control in its Application to Specification Requirements, where two outstanding authorities, Colonel L. E. Simon, Head, Ballistic Research Laboratory, Aberdeen Proving Ground, U. S. Army Ordnance, and Joseph Manuele, Director, Quality Control Department, Westinghouse Electric Corp., presented papers.

Local arrangements for the Spring Meeting and Committee Week were handled by the Pittsburgh District Committee through the intensive efforts of Chairman Thomas Spooner and Secretary P. G. McVetty, both of Westinghouse Electric Corp. Cooperating with them in connection with the technical features of the Spring Meeting were J. J. Bowman, Aluminum Company of America, and Prof. F. T. Mavis, Carnegie Institute of Technology. Messrs. Spooner and McVetty should be given much credit for the success of the meetings. Mention might also be made of the efficient way in which the Pittsburgh Convention Bureau took care of the Housing Bureau which allocated members to the various hotels and also supplied personnel to handle A.S.T.M. registration details. The various hotels, including the William Penn particularly, cooperated splendidly in connection with sleeping room facilities.

Statistical Quality Control

Both the President of the Society, J. R. Townsend, Bell Telephone Laboratories, Inc., who opened the meeting, and the technical chairman, H. F. Dodge, also of the Bell system, stressed the growing importance of quality control in connection with obtaining the desired quality of materials, and it was evident after hearing the two speakers, Colonel Simon and Mr. Manuele, that there has been widespread application of the fundamentals, particularly during wartime.

Colonel Simon, who is one of the most articulate of those concerned with statistical quality control, in his paper "Dollars for Your Thoughts" prefaced his remarks with a statement by C. I. Lewis that "all empirical knowledge is probable only." Generally, he stated that statistical methods offer a means for determining in an economic way (1) what product one wants, (2) what product one should strive to get, and (3) how one can operationally verify with a chosen probability that the accepted product will meet the requirements of the one he chooses to try to get. By taking the thought necessary to achieve steps (1), (2), and (3) both purchaser and vendor can be saved great expense. With reference to quality control which he would more properly term "quality determination," Colonel Simon pointed out that with many of the present specifications the prospective purchaser may have only a vague idea of what he needs, but by setting the level of quality high enough he may muddle through, but a satisfactory product could probably be procured for a much lower price with proper considerations.

Mr. Manuele's paper on "Use of Statistics in Writing Specifications" in which Dr. Goffman collaborated, gave a number of specific details of applying statistics. He pointed out that specifications which should define the desired quality of any products for utilitarian or aesthetic purposes must embody accuracy, that is, must define the desirable quality level and its permissible variation with sufficient clarity to allow definite discrimination between good and bad lots, and furthermore, must permit this discrimination without 100 per cent inspection. He went on to define a number of the terms used in statistical analysis with specific examples of application. Some of his examples related to the hardness of castings, screw machine parts, and the use of cotton yarn covering wire for motor windings.

The complete papers are published later in this BULLETIN and it is planned to issue reprints which will include the interesting discussions by other authorities in this field.

Symposium on Atmospheric Exposure Tests on Non-Ferrous Metals

In order to provide an evaluation and correlation of the extensive data which have resulted from the long-time, country-wide atmospheric exposure tests on non-ferrous metals as carried out by A.S.T.M. Committee B-3, a symposium on the subject featured two sessions of the Spring Meeting. Leading authorities who took part in the tests and

Quality Control and Corrosion Papers to Be Published

The papers by Col. Simon and Messrs. Goffman and Manuele are published elsewhere in this BULLETIN and they will be reprinted together with the discussion presented at the Pittsburgh session. The complete reprints will be available at a nominal price. Further announcement will be made. The Symposium on Atmospheric Exposure Tests on Non-Ferrous Metals will be issued as a special publication later in the year, and members will be given the opportunity of ordering copies at special prices. Publication date will probably not be before about July 30.

who are active in the committee work prepared the papers on the families of alloys with which their companies were very directly interested. Thus E. A. Anderson, New Jersey Zinc Co., covered zinc; W. A. Wesley, The International Nickel Co., Inc., covered nickel; A. W. Tracy, The American Brass Co., discussed copper alloys; G. O. Hiers, National Lead Co., covered lead and tin; E. H. Dix, Jr., and R. B. Mears, Aluminum Company of America, covered aluminum-base alloys; and the concluding paper by members of the technical staff of the Bell Telephone Laboratories dealt with the subject of "Tracking Trouble in Atmospheric Corrosion Tests," being a detailed coverage of statistical investigations of the tests and results.

The list of papers, authors and session chairmen follows:

SYMPOSIUM ON ATMOSPHERIC EXPOSURE TESTS ON NON-FERROUS METALS

Afternoon Session—Chairman: W. H. Finkeldey, Singmaster and Breyer Co.

The Corrosion of Rolled Zinc in the Outdoor Atmosphere—E. A. Anderson, Research Div., New Jersey Zinc Co. (of Pa.)

The Behavior of Nickel and Monel in Outdoor Atmospheres—W. A. Wesley, Assistant Director, Research Laboratory, The International Nickel Co., Inc.

Resistance of Copper Alloys to Atmospheric Corrosion—A. W. Tracy, Metallurgist, The American Brass Co.

Evening Session—Chairman: J. J. Bowman, Aluminum Company of America

The Use of Lead and Tin Outdoors—G. O. Hiers, Research Laboratories, National Lead Co.

The Resistance of Aluminum-Base Alloys to Atmospheric Exposure—E. H. Dix, Jr., Assistant Director of Research, and R. B. Mears, Head, Chemical Section, Aluminum Company of America

Tracking Trouble in Atmospheric Corrosion Tests—W. E. Campbell, P. S. Olmstead, and H. G. Romig, Bell Telephone Laboratories, Inc.

The Society plans to publish these papers together with the extensive discussion in a special volume to be available later in the year.

Several New Specifications and Tests Accepted

Standards Committee Actions Involve Cement, Rubber, Shipping Containers and Alloy Castings

A NUMBER of actions on standards including several new tentatives have been approved by the Administrative Committee on Standards in recent weeks. These various recommendations have come through from committees working on cement, electrical-heating and electrical-resistance alloys, rubber and rubber-like materials, and shipping containers. The accompanying table lists the various items and the notes which follow give some idea of just what the standards cover.

Specifications and Tests for Cement:

The new Tentative Specifications for Portland Blast-Furnace Slag Cement (C 205) define the material, cover additions, chemical and physical requirements, packaging, storage, etc. This material is defined as an intimately interground mixture of portland cement clinker and granulated blast-furnace slag, the slag constituent of which shall not be less than 25 per cent and shall not exceed 65 per cent.

The new methods for fineness of portland cement by air permeability apparatus (C 204) are based on very extensive work, much of which has been carried out at the National Bureau of Standards. The method is based on the Blaine apparatus and procedure, and gives the determination in terms of the specific surface expressed as total surface area in square centimeters per gram of cement.

The Blaine apparatus consists essentially of a means of drawing a definite quantity of air through a prepared bed of cement of definite porosity. The number and size of the pores in a prepared bed of definite porosity is a function of the size of the particles and determines the rate of air flow through the bed.

Papers describing the procedure and the results of cooperative tests have been published by the Society, particularly in the ASTM BULLETIN.

Revisions in the Method of Tests for Air Content (C 185) relate to the construction and use of the Burmister flow trough. The equipment is more adequately described and will promote uniformity in the apparatus and the testing procedure.

The changes in the Tentative Specifications for Air-Entraining Portland Cement (C 175) broaden the scope by deleting the reference to pavements, give revised methods for adding the resin, change the air content requirement from the present value of 14 ± 4 per cent to 16 ± 4 per cent, and give some added requirements on the containers.

The new Method of Chemical Analysis for Darex Air-Entraining Agent, to be a part of the General Methods of Chemical Analysis of Portland Cement (C 114), is based on a procedure recommended by the American Public Health Association and the American Waterworks Association for determining albuminoid nitrogen in water. The material covered, namely Darex, is essentially a triethanolamine salt of a sulfonated hydrocarbon.

Drum Test for Shipping Containers:

The revolving hexagonal drum test for shipping containers has been used for many years. Originally the Forest Products Laboratory did extensive work, and the development of a machine and some data on the tests were first described in the ASTM *Proceedings* in 1916. Since then the use of the test has grown and although there has been reasonably good standardization of the equipment and the results there-

from, Committee D-10 on Shipping Containers felt it quite desirable that the various details be set up in a new tentative method which has just been approved with the designation D 867. This test is intended to give an indication of how well a shipping container will withstand the various shocks and impact stresses simulating those which might be expected in shipment or handling. Two types of drum are used, a 7-ft. and 14-ft. drum. Baffles are arranged on the interior faces, and as the drum revolves the box drops from one baffle to another. The new test gives various requirements on operating the drum, observance of the specimen during the test, and the detailed matters which must be reported.

Test for Heat Aging of Vulcanized Rubber:

The new method for Heat Aging of Vulcanized Natural or Synthetic Rubber by Test Tube Method (D 865) is based on considerable work carried out in Committee D-11, particularly Technical Committee A on Automotive Rubber. Existing methods of aging materials at elevated temperatures in air have not been too satisfactory from the reproducibility and control standpoint. Essentially this method consists of subjecting test specimens having previously determined physical properties to controlled deteriorating influences for known periods, after which the physical properties are again measured and the changes noted. In this method the test involves exposure of specimens to air at an elevated temperature and at atmospheric pressure.

It is aimed to give an estimate of the relative resistance of vulcanized rubber to high-temperature aging in a controlled and limited quantity of air. No direct correlation between this accelerated test and natural life of rubber is given or implied. Since the rate at which deterioration proceeds during the normal life of rubber varies widely depending on conditions of exposure to heat, light and air, and on the composition and state of cure of the rubber, this accelerated test is comparative only and must be evaluated against the performance of rubber compounds of which both the natural and accelerated aging characteristics are known.

Electrical Resistance Alloys:

The new Tentative Specification for Nickel-Chromium-Iron Castings for High-Temperature Service (B 207) cover iron-base heat-resisting alloy castings of the 35 per cent nickel, 15 per cent chromium class, intended for structural elements, containers, supports, resistors, and the like in electric furnaces and for similar applications in oxidizing and carburizing atmospheres up to 1900 F. The purchaser is to inform the manufacturer as to service temperatures and atmospheres.

The revisions of the Test of Electrical Contact Materials (B 182) are mainly editorial although there are some minor substance changes. The withdrawal of the two specifications indicated in the accompanying table (B 82 and B 83) tie in with the recommendation the Committee will make in June that the two existing Tentatives (B 82 – 44 T and B 83 – 44 T) be adopted as standard this year.

Actions by the Administrative Committee on Standards, January–March, 1946

New Tentatives

Specifications for:
- Portland-Blast Furnace Slag Cement (C 205 – 46 T)
- Nickel-Chromium-Iron Alloy Castings (35-15 Class) for High-Temperature Service (B 207 – 46 T)

Method of:
- Test for Fineness of Portland Cement by the Air-Permeability Apparatus (C 204 – 46 T)
- Test for Shipping Containers in Revolving Hexagonal Drum (D 867 – 46 T)
- Heat Aging of Vulcanized Natural or Synthetic Rubber by the Test Tube Method (D 865 – 46 T)
- Chemical Analysis for Darex Air-Entraining Agent in Portland Cement (to be added to C 114 – 46 T)

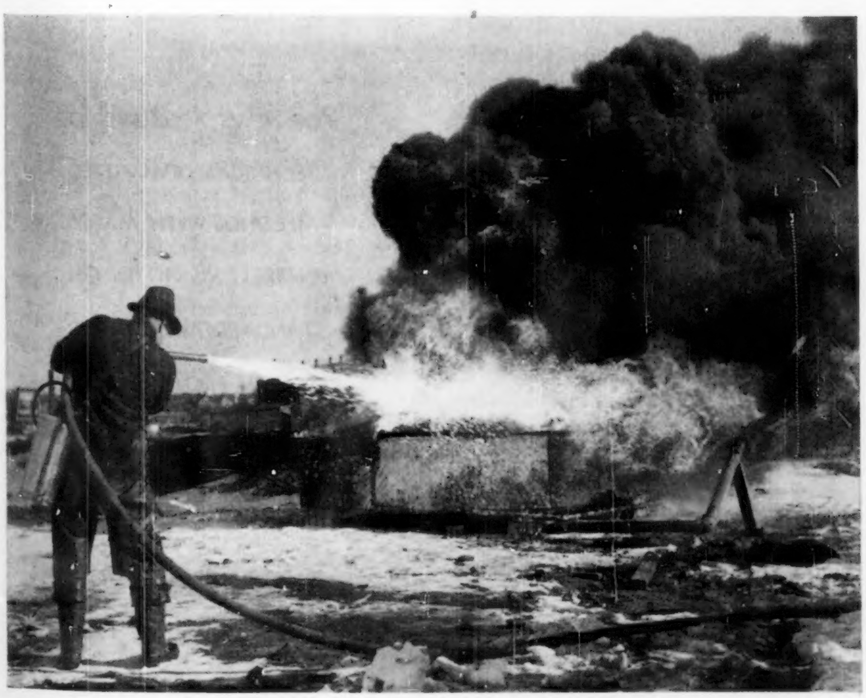
Revision of Tentatives

Specifications for:
- Air-Entraining Portland Cement for Concrete Pavements (C 175 – 46 T)

Method of:
- Test for Air Content of Portland Cement Mortar (C 185 – 46 T)
- Life Test of Electrical Contact Materials (B 182 – 46 T)

Withdrawal of Standards

- Specifications for Drawn or Rolled Alloy, 80 per cent Nickel, 20 per cent Chromium, for Electrical Heating Elements (B 82 – 41)
- Specifications for Drawn or Rolled Alloy, 60 per cent Nickel, 15 per cent Chromium, and Balance Iron, for Electrical Heating Elements (B 83 – 41)



Prize-Winning Photograph in 1940 Photographic Exhibit

(See page 8 for details of 1946 Exhibit)

Standards Supplements Completed; Other Publications Off Press

WITH the receipt from the printer of the 1945 Supplement to Part I of the Book of Standards, the three Supplement Parts I, II, and III have been completed. Members should by now have received the respective books to which they are entitled. In connection with the next Book of Standards, unquestionably the Society's most important publication, it has been decided to continue it on a biennial basis. Thus in 1946 a complete new big book will be issued. It is the hope that this can again be published in three parts. Detailed studies of various methods of splitting the books into more parts have resulted in the conclusion that if somewhat lighter weight paper can be obtained, so-called "bible" paper for example, the books can still be issued even though they will contain considerably more material than the 1944 book. Parts I and III at the present time are about as big as can be reasonably bound and handled. While it is premature to predict how many pages will be in the complete 1946 Book, the three parts together might aggregate about 7000 pages.

The decision to issue a complete new book late in 1946 means that there will only be one supplement to the 1944 Book.

One result of the decision to publish a complete book in 1946 will be intensive activity on the part of all technical committees to get their various specifications, tests, definitions, etc., in as final form as possible. We can anticipate that many of the existing tentatives and also tentative revisions of standards will be adopted this year.

Special Compilations:

The latest compilation of standards to be issued is the one covering Paint, Varnish, Lacquer and Related Products, a 546-page book with the more than 160 specifications, tests and definitions covering this field, most of which have been issued through the work of Committee D-1. A separate prospectus-order blank has been dispatched to the members so that they can order this publication. It is listed at $2.75 per copy, the member's price being $1.80.

Before this BULLETIN reaches the members, another compilation should be available covering Rubber and Rubber-like Materials. This also is an extensive book with all of the widely used standards and tentatives developed by Technical Committee D-11 together with some related standards. Standard methods and specifications fall into such classifications as general test methods; electrical tests; hose, belting, gloves, matting, tape; insulated wire and cable; miscellaneous products; nonrigid plastics; nomenclature and definitions. This new book, covering 560 pages, can be procured by members at $2.20 per copy, the nonmembers price being $3.25.

Committee B-4 on Electrical-Heating, Electrical-Resistance and Electric-Furnace Alloys is sponsoring a new edition of its compilation of standards and while the exact data when this can be shipped to the members is uncertain, it should be available within the next six weeks.

Special Publications:

Progress is being made on the volume containing all Methods of Chemical Analysis of Metals which includes all of the methods issued by Committee E-3 and which is essentially a part of the Book of Standards since this volume is the only place where these analytical methods are published. It will not be available until the late spring. Members will be given an opportunity to request a copy of this publication and to order extra copies. It is expected a special return form will be distributed in April or May.

Another publication in the offing is the Symposium on Adhesives which was sponsored by Technical Committee D-14 at its late 1945 meeting. The several papers are being put in type and further announcement will be made concerning this booklet which is expected to aggregate about 60 to 70 pages.

There has just been issued a 1945 Supplement to the Bibliography and Abstracts on Electrical Contacts. This important work was sponsored by Committee B-4 with the first volume issued covering the years 1835 to 1943, a 140-page book. Last year a 32-page Supplement was issued and the latest one covering references through 1945 is a pamphlet of 16 pages. Members could procure the original publication at a special price of $4.00 with the first Supplement priced at $1.50 and the latest Supplement at 40 cents. The three publications combined can be procured at the special members price of $4.50. This was the same combination price effective for the original book and first Supplement. List prices to nonmembers are $5.00, $2.50, and 50 cents respectively, with a combination price of $6.00.

Another pending publication is the Symposium on Ultra-High Voltage and High Speed Radiography developed under the auspices of Committee E-7. A news account of the meeting appears elsewhere in this BULLETIN. The several interesting technical papers and discussions are to be issued in a special symposium book and should become available in the next few months.

FOR NEWS ACCOUNTS OF TECHNICAL COMMITTEE MEETINGS WITH MANY INTERESTING NOTES ON STANDARDIZATION AND RESEARCH PROJECTS UNDER WAY, AND IN PLANNING STAGE, SEE PAGES 56 TO 72.

Use of Statistics in Writing Specifications

By Casper Goffman[1] and Joseph Manuele[1]

EDITOR'S NOTE.—Because of the diverse activities of the many technical committees and groups in the Society, it is usually the situation that a particular technical paper or series of papers or reports are chiefly of interest to a certain segment of the membership but some of the items should be of interest to *every* A.S.T.M. member and committee member. We feel that this latter situation holds with respect to the papers by Colonel Simon and Messrs. Goffman and Manuele printed below. There has been growing emphasis on the importance of quality control and unquestionably every materials engineer and technologist concerned with materials and engineering products will be hearing more about statistical quality control. A great deal has been published on these subjects, much of it of great value particularly to the statistical or quality control engineer, but much of it also not quite as "down to earth" as one might wish. Messrs. Simon and Manuele are among the growing group of authors on quality control who embody in a very desirable degree a profound, intimate grasp of the subject intermingled with the faculty of reporting their ideas and thoughts articulately.

There was considerable discussion at the Pittsburgh meeting at which these papers were presented, which discussion either will be published in our May BULLETIN or most certainly with the reprint which will be issued. The Society will publish the papers and discussion in a separate booklet and copies can be procured during the early summer. Further announcement will be made.

BY THE word "specification" as used in this paper is meant any specification employed for the purpose of defining the desired quality of any product for utilitarian or aesthetic purposes. A specification is necessary because different lots of the same product might possess the same quality characteristic in different degrees, whereas, for best results, it is desired that the particular quality characteristic be maintained at a definite level and within very definite limits. It is the function of the specification to define this level of quality and the limits within which the quality level may be allowed to vary.

For this purpose the specification must possess two operating characteristics:

1. *Accuracy.*—The specification must define the desirable quality level and its permissible variation with sufficient clarity as to allow definite discrimination between good lots and bad lots.

2. *Economy.*—The specification must permit discrimination between good lots and bad lots without the requirement of 100 per cent inspection, or the examination of all units in a lot. This is particularly important in the case of destructive testing, where the test operation itself would leave us no "good parts."

The fundamental characteristic of a manufactured product which makes the application of statistical measurements essential is the variation inherent in the product. No two pieces produced are exactly alike regardless of the refinement of the process. Although in some cases the differences are smaller than can be detected with the measuring devices on hand, we can be assured that differences do exist.

For example, two cylinders supposedly finished to 1-in. lengths may both appear to be exactly the same length, 1 in., when measured with a 6-in. scale. However, when checked with a micrometer, we may find that one cylinder is 1.002 and the other is 0.998 in. Again on precision work, a micrometer may not detect differences which are readily measurable with an electric gage.

To judge the quality of a lot of material with respect to a certain dimension, we should know the average of this dimension; but besides the average we should also have further information. Suppose the journal diameter of a motor shaft is specified to be 1.000 ± 0.001 in. A lot of 500 shafts is received and a sample of ten is taken at random. The journal diameters of the ten shafts are found to be:

1.0025*	0.9990
1.0005	1.0010
0.9975*	1.0005
1.0000	0.9995
0.9985*	0.9995

The average journal diameter of the ten shafts is 0.99985 in. This is very near to the center of the tolerance range, 1.000 in. Yet three of the shafts (marked with asterisks), 30 per cent of the sample, are outside the tolerance limits. It is obvious that the average alone of a sample cannot be used as a criterion for acceptance. In addition, we need a measure of the fluctuation from part to part, an index of the variability of the lot.

The index of variability of a set of observations generally used is the *standard deviation* of the observations from their average. Those familiar with the theory of alternating current electricity will recognize this as the "root mean square deviation." To calculate the standard deviation of a set of observations, obtain the square of the difference of each observation from the average, sum these squares, divide by the number of observations, and extract the square root. Symbolically, the standard deviation of a number of observa-

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia 2, Pa.

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tions from their average, $\bar{X}$, may be represented by the equation:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} (X_i - \bar{X})^2}{n}}$$

where

σ = standard deviation,
X_i = the values of the observations, and
n = the number of observations.

The standard deviation of a set of observations is designated by

TABLE I.—MEASUREMENTS OF 50 PIECES IN INCHES.

4.450	4.451	4.450
4.449	4.452	4.450
4.449	4.454	4.452
4.450	4.453	4.450
4.452	4.450	4.449
4.452	4.450	4.450
4.451	4.453	4.449
4.452	4.449	4.447
4.451	4.447	4.448
4.451	4.450	4.449
4.452	4.450	4.449
4.452	4.448	4.450
4.451	4.450	4.451
4.451	4.450	4.450
4.448	4.450	4.448
4.450	4.448	4.449
4.451	4.449	

TABLE II.—MEASUREMENTS ARRANGED AS FREQUENCY TABLE.

Length of Piece, in.	Number of Pieces
4.455	0
4.454	1
4.453	2
4.452	7
4.451	8
4.450	16
4.449	9
4.448	5
4.447	2
4.446	0
4.445	0

the Greek letter σ. The standard deviation of the entire lot is designated by σ'. The average of a set of observations is designated by $\bar{X}$. The average of the entire lot is designated by $\bar{X}'$. In general, $\bar{X}$ and σ calculated from a sample will be somewhat different from $\bar{X}'$ and σ'. Moreover, a succession of samples of ten taken from a lot will have averages and standard deviations which themselves fluctuate from sample to sample. However, the larger the size of the sample, the nearer will $\bar{X}$ and σ be to $\bar{X}'$ and σ', respectively. For most practical purposes, the $\bar{X}$ and σ calculated from a sample over 50 in size may be taken to be the average $\bar{X}'$ and standard deviation σ' of the entire lot without great danger, and this is sometimes done.

This leads us to the concept of frequency distribution. We illustrate this concept by means of a sample of 50 taken from a lot of screw machine parts whose over-all length is required to be 4.450 ± 0.010 in. The measurements obtained are shown in Table I. These data do not give much information in their present form. However, the data can be reorganized as shown in Table II so as to become very enlightening. A survey of the data shows that exactly 16 pieces were 4.450 in. long, eight pieces were 4.451 in. long, nine were 4.449 in. long, etc.

Such a table is called a *frequency distribution*. It merely indicates the number, or frequency of occurrence, of measurements in each size. In practice, the pieces may be tallied as they are measured, as shown in Fig. 1.

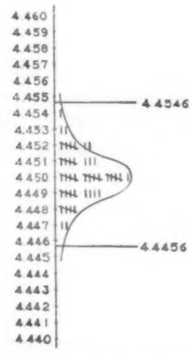

Fig. 1.—Measurements Tallied as Frequency Distribution.

This gives visual meaning to the frequency distribution. It will be noted that it is bell-shaped and symmetrical about the center, high in the center, and falls off sharply at the ends. The envelope curve of the tallied marks is known as the *frequency curve*. A distribution with shape such as the one shown here is called a *normal distribution*. In the majority of cases encountered in industry, a controlled process will produce parts which are normally distributed.

However, when making predictions on the basis of $\bar{X}'$ and σ', one need not have any fears about the normality of the distribution, since for any distribution, regardless of how unusual or weird its shape, 89 per cent or more will fall within $3\sigma'$ of the average as compared with 99.7 per cent for a normal distribution.

In our case of the 50 screw machine parts shown in Fig. 1, the average $\bar{X}$ is 4.4501 in. and the standard deviation σ is 0.0015 in. If we take these values to be the same as the average $\bar{X}'$ and standard deviation σ' of the lot, we can say that:

$$\bar{X}' \pm 3\sigma' = 4.4501 \text{ in.} \pm 3(0.0015 \text{ in.})$$
$$= 4.4456 \text{ in.} \longleftrightarrow 4.4546 \text{ in.}$$

and that practically all parts in the entire lot are between these limits.

Since the specification limits are 4.440 and 4.460 in., we accept the lot. Of course, we have not taken into account the small error in $\bar{X}'$ and σ' due to the fact that they have been calculated from a sample of 50 and that we do not know the true average and standard deviation for the entire lot. To go into the theory of the probable sizes of these errors is beyond the scope of this paper. However, we can say that the error made in estimating $3\sigma'$ from 3σ is almost certainly less than 0.00045 in., $\left(\frac{3\sigma}{\sqrt{2n}} = \frac{3(0.00015)}{\sqrt{2 \times 50}}\right)$ and the error made in estimating $\bar{X}'$ from $\bar{X}$ is almost certainly less than 0.00064 in., $\left(\frac{3\sigma}{\sqrt{n}} = \frac{3(0.00015)}{\sqrt{50}}\right)$.

We may now proceed to write our specification for these screw machine parts, using the statistical measures we have learned.

Specification.—From the lot, take a sample of 50 parts at random. Measure each of the 50 parts and calculate $\bar{X}$ and σ. Accept the lot if $\bar{X}$ is between 4.4456 and 4.4544 in. and σ is equal to or less than 0.0015 ± 0.00045 in. = 0.00195 in. (see Fig. 7).

This specification is slightly favorable to the purchaser. If, instead of adding the possible error 0.00021 in. in the average to 3σ = 0.0045 in., we had subtracted it, we would get the value 0.0043 in. which would then give the action limits 4.4566 and 4.4434 in. These limits would be slightly favorable to the producer. The dilemma can be dissolved by reserving judgment when $\bar{X}$ is between 4.4566 and 4.4544 in. or between 4.4456 and 4.4434 in. However, in this particular case the differences are so slight that it is needless to take this precaution.

The manner in which this speci-

fication operates is indicated in Fig. 2. Of the 15 lots shown here, the sixth, tenth, and twelfth were rejected. All other lots in this run were accepted.

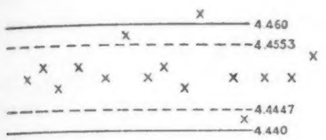

Fig. 2.—Application of Specification on Screw Machine Part.

How does this plan comply with the requirements of accuracy and economy set forth at the beginning of this paper? It certainly is an accurate plan. It will accept practically all good lots and will reject practically all bad lots. On the other hand, it is not an economical plan. With σ as small as it is, compared to the range of the tolerance limits, it should be possible to construct an accurate plan using sample sizes much less than 50. This leads naturally to the concepts "control" and "control chart."

An important idea in the application of statistics is *statistical control*. In a broad sense control means consistency. Statistical control thus means statistical consistency. The simplest interpretation of this is that the frequency distribution should remain constant; that is, that $\bar{X}'$ and σ' should be essentially the same for all lots. If a state of statistical control has been achieved, it is possible to reduce sample size drastically and retain assurance that quality is being maintained. The vehicle for determining whether a product is in control is the control chart as developed by W. A. Shewhart of the Bell Telephone Research Laboratories.

Table III(a) shows a frequency distribution of 300 pieces taken from a lot of 900 rivets. Table III(b) shows a frequency distribution of averages of 50 samples of 5 pieces each taken from the same lot.

For the 300 individual observations, $\bar{X}$ = 0.1715 in. and σ = 0.00089 in. For the 50 averages of samples of five, $\bar{X}$ = 0.1715 in. and σ = 0.00036 in. The average of samples of five will be the same as the average of the individuals for a lot. The standard deviation of averages of five may be obtained by dividing the standard deviation of individuals by $\sqrt{5}$. In this case, for samples of five, $\sigma = \frac{0.00089 \text{ in.}}{\sqrt{5}} = 0.00035$ in. This calculated value agrees rather closely with the actual value, 0.00036 in. For any sample size, n, averages will be distributed with the same average as individuals but with standard deviation $1/\sqrt{n}$ times the standard deviation of individuals.

Let us suppose now that we are interested in writing a specification covering the hardness of gray iron

TABLE III.—FREQUENCY DISTRIBUTION OF AVERAGES COMPARED WITH FREQUENCY DISTRIBUTION OF INDIVIDUALS.

Size, in.	(a) Number of Pieces	(b) Number of Averages of 5
0.1742	1	
0.1740	1	
0.1738	0	
0.1736	1	
0.1734	2	
0.1732	7	
0.1730	6	
0.1728	8	
0.1726	13	
0.1724	7	
0.1722	18	3
0.1720	11	6
0.1718	40	12
0.1716	56	14
0.1714	19	4
0.1712	42	5
0.1710	11	4
0.1708	18	2
0.1706	6	
0.1704	4	
0.1702	2	
0.1700	4	
0.1698	3	
0.1696	8	
0.1694	2	
0.1692	4	
0.1690	3	
0.1688	1	
0.1686	1	

castings. We do not want any casting harder than 220 Brinell nor softer than 150. Let us further suppose that we have taken samples of 50 from a succession of lots and that we have found $\bar{X}$ and σ to be consistent in value from lot to lot. For ten consecutive lots these Brinell values are shown in Table IV. These lots have $\bar{X}$ and σ sufficiently consistent that variations may be considered as due only to chance. Hence, we take as our true average $\bar{X}'$, and our true standard deviation, σ', the average of $\bar{X}$ (182.3) and σ (10.09) for these ten lots. We shall assume that this will be the average and standard deviation for all subsequent lots until a significant change in these values occurs.

We wish to take samples of five for reasons of economy. Hence we need to know the standard deviation for averages of five. This is $\frac{10.09}{\sqrt{5}} = 4.51$ and $3\sigma' = 13.53$. Hence for samples of five our control limits will be at $182.3 \pm 13.53 = 195.83 \longleftrightarrow 168.77$. For averages of 50 the control chart limits will be at $182.3 \pm \frac{3 \times 10.09}{\sqrt{50}} = 186.6 \longleftrightarrow 178.0$.

We may now write a specification for this item:

Specification. 1. Take samples of 50 from each lot and check for Brinell hardness and pass all lots for which $\bar{X}$ is between 186.6 and 178.0. If ten consecutive lots are accepted,

2. Construct a control chart with limits at $\bar{X}' \pm 13.5$, (182.3 ± 13.53) where $\bar{X}'$ is the average of the total sample of 500. Now take samples of 5 from each lot and pass all lots if $\bar{X}$ for the sample falls within the control limits, 195.83 and 168.17 and σ is less than 17.9, (10.09×1.789), where 1.789 is the factor B_2, p. 39, American War Standard Z1.3.

3. If an average or standard deviation of any sample of 5 falls outside the control limits, go back to samples of 50 as in (1) above.

Figure 3 shows how this plan operates. The sigma chart is not shown.

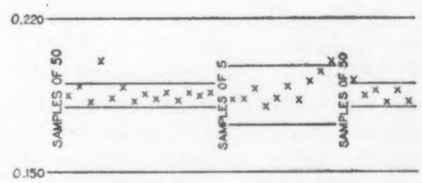

Fig. 3.—Application of Specification on Castings.

TABLE IV.—DATA ON HARDNESS OF CASTINGS FOR TEN CONSECUTIVE LOTS.

Lot	$\bar{X}$	σ
No. 1	183	9.2
No. 2	182	10.7
No. 3	186	9.5
No. 4	180	11.3
No. 5	184	10.4
No. 6	181	9.6
No. 7	179	9.0
No. 8	183	10.2
No. 9	180	10.7
No. 10	185	10.4

The question might arise: Why cannot we use a plan such as the one used in the specification for the

screw machine part instead of a control chart? The answer is simple. We recall that to get our limits we went a distance 3σ plus the possible error due to chance on the average and standard deviation below the upper tolerance limit to get the reduced upper limit. In this case, $3\sigma = 30.27$, chance error of average of five is 13.53, and upper tolerance limit is 220. Hence, the upper reduced limit is $220 - 43.8 = 176.2$. The lower tolerance limit is 150. Hence, the lower reduced limit is $150 + 43.8 = 193.8$. Since these limits overlap we cannot use this type of plan.

In general, then, if 3σ is quite small compared to the half tolerance range, we use a reduced limits plan. If 3σ is nearly as large or larger than the half tolerance range and we are in position to take small samples, we use a control chart plan.

We now give an example of a specification before and after statistics were applied. We show what was wrong with the specification as originally written and how statistics improved the situation.

Let us consider cotton yarn to be used for covering wire for motor windings and other insulating purposes. It should be evident that cotton yarn used for this purpose should be of proper diameter and tensile strength. The test for tensile strength was made in accordance with the skein method in the A.S.T.M. General Methods of Testing and Tolerances for Cotton Yarns (D 180–44).[2] Considerable trouble was encountered in application of cotton-covered wire to motor windings due to an excessive number of cases where the wire was oversize, making it difficult to wind. Checks were made on the bare copper wire and on the thickness of enamel covering of the wire. These were both found to be within limits. This led to the belief that it must be the cotton yarn.

It was found that the specification was so worded that the chance of accepting defective yarn was good. The dimensional quality of the yarn, which has reference to its diameter, is identified by a "yarn number." A curve translates weight in grains of a standard length (120 yd.) of yarn into yarn number. Reference to Fig. 4 will show that the yarn number decreases as the weight (diameter) of the yarn increases.

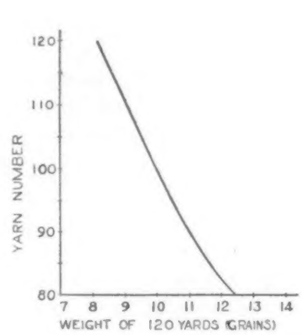

Fig. 4.—Chart for Determining Yarn Numbers.

For the type of yarn used in largest quantities, the desired yarn number was 100 with tolerance limits of ±10. This meant ±10 tolerance limits for all the cotton, not just that which happened to be sampled. The specification merely stated "the yarn number of each case of yarn shall not vary more than ±10 from that specified on the Purchase Order." The specification did not say what was meant by the yarn number of a box. The inspector interpreted it to mean that the average of ten specimens, one taken from each of ten spools, selected so as to be representative of the box, should be within ±10 of the nominal value of the yarn number. In the case under consideration the nominal value was 100, making the limits 90 and 110.

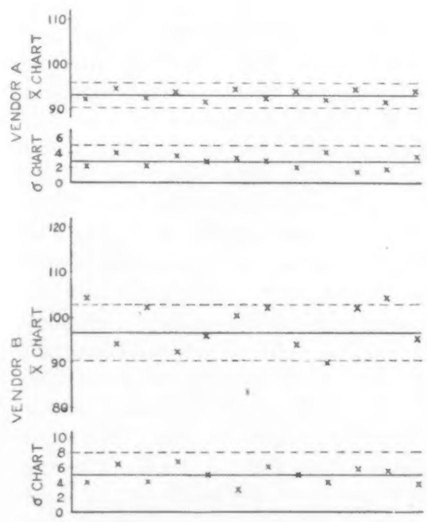

Fig. 5.—Comparison of Two Vendors.

Data were collected from inspection reports and plotted in control chart form. For the two main vendors the control charts were as shown in Fig. 5.

According to the charts, both vendors A and B seem to be in control. However, vendor A is shipping

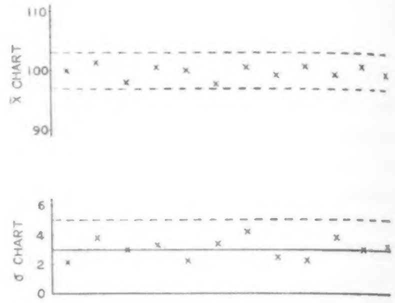

Fig. 6.—Chart for Vendor with Good Quality.

heavy yarn. Since $\bar{\sigma} = 3$ and $\bar{\bar{X}} = 93$ (see Fig. 5), and since 68 per cent of all parts will be within $1\bar{\sigma}$ of $\bar{\bar{X}}$, $\frac{1}{2}(32) = 16$ per cent of all yarn will be outside of tolerance limits, will be too heavy.

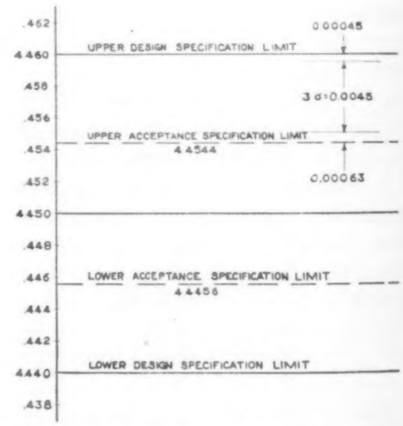

Fig. 7.—Construction of Specification on Screw Machine Part.

Vendor A can make good yarn as evidenced by his $\bar{\sigma} = 3$ but must make his yarn lighter. Vendor B's trouble is more serious. His $\bar{\sigma}$ is too large. In order for his yarn to meet requirements, he must probably make improvements in his process.

[2] 1944 Book of A.S.T.M. Standards, Part III, p. 784.

It was realized, on the basis of this study, that the specification must be rewritten so as to discriminate between good and bad lots more accurately. It was rewritten as follows:

Specification.—The yarn number of a box of yarn shall be considered as the average of a sample of ten specimens, one taken from each of ten spools, selected so as to be representative of the box.

The yarn number of each box of yarn shall be within three of the number specified on the purchase order, 100 in this case.

The results for successive boxes shall be entered on a control chart for $\bar{X}$ and σ, with limits at 97 and 103 for $\bar{X}$ and at 0 and 5 for σ.

Vendors who are out of control or who have a σ too large on the average will be notified so that the trouble can be corrected.

For a vendor with an acceptable product the charts were as shown in Fig. 6.

Dollars for Your Thoughts[1]

By Leslie E. Simon[2]

"All empirical knowledge is probable only"—C. I. Lewis

Statistical methods offer a means for determining in an economic way (1) what quality of product one wants, (2) what product one should strive to get, and (3) how one can operationally verify with a chosen probability that the accepted product will meet the requirements of the one he chooses to try to get. By taking the thought necessary to achieve steps (1), (2), and (3) both purchaser and vendor can be saved great expense.

THINK. In the Ballistic Research Laboratory, Aberdeen Proving Ground, in which I have served during the greater part of the war, some semi-serious jokester put up a series of signs. One sign read, "Insanity is not a prerequisite for employment here, but it is not without its advantages;" another, "The impossible we do quickly: miracles take a little longer;" and one sign was merely the monosyllable, "THINK." At first glance, the sign might seem facetious in a research laboratory; but on further consideration perhaps it, too, is not without its advantages. I let the sign stay.

Generally speaking, thinking is an unpleasant process; and quite often we adopt rules of thumb, accept customary procedures, or make a show of dealing only with the broad aspects of a thing in order to escape thinking and yet not have to admit our lack of fortitude. I do not wish to advocate making life unpleasant, but only to point out one phase of business where thought has such a leverage factor both in material gain and in the avoidance of future troubles that it is worth while. This phase of business has to do with acceptance specifications; with thinking out clearly at the start, what we want and how we are going to set about getting it.

I believe that in a brief discussion I can show that by taking appropriate thought about specifications, and without any radical change in ordinary purchase-vendor relations, business and industrial firms can save themselves considerable effort, time, and money. At the same time I shall point out the methods and bases for attaining these advantageous conditions.

In order to demonstrate these two points, the magnitude of the gain and the basis for attaining it, I shall have to discuss: (1) specifications (*a*) as they are, and (*b*) as they could be; (2) two attitudes of mind, the older of which is associated with certainties and fixed dimensions, whereas the newer accepts uncertainties to the extent of admitting that all practical affairs are merely more or less probable and all dimensions terminate in vague areas of tolerance ranges; (3) a statistical method which is often called *quality control* but which more properly should be called *quality determination* when used in connection with purchasing specifications; and (4) some practical considerations which must enter into the use of any system or method no matter how near it may be to ideal.

Specifications as They Are

In general the prospective purchaser of a product has only a vague idea of what he needs. He or his engineering staff generally believes that the economic level of quality of product could be determined but that it is not worth while because even if he knew precisely what he wanted, it would be impossible to specify completely even the simplest article and furthermore he would probably never succeed in purchasing precisely that kind of article. Consequently he makes a rough estimate of what he thinks is required; and writes a specification in which he sets the level of quality quite high enough to allow a liberal margin for error. He relies to a considerable degree upon chance, the integrity of the vendor, and contemplated oral discussions to get what he wants; and hopes for the best. This sort of *muddling through* often succeeds

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia 2, Pa.

[1] Presented as part of the Symposium on Quality Control, A.S.T.M. Spring Meeting, February 26, Pittsburgh, Pa.

[2] Colonel, Ordnance Dept., Aberdeen Proving Ground, Md.

in the sense that a satisfactory product is obtained, but even then it may by no means be the *economical* product. The product may be satisfactory because it is of much higher quality than that needed while a satisfactory product could be procured at a much lower price. When the procedure fails it is generally blamed upon bad judgment, poor engineering, or an unreliable vendor.

Example of Poor Design Specification

It is manifest that a primary consideration in the writing of a specification is a clear knowledge of just what one wants. Let us call the description of the ideal the *design* specification because that is what Shewhart called it when he laid some sound principles for the writing of specifications in 1934.[3] Of course the ideal quality described by the design specification is a thing apart from the purchasing specification in which our major interest lies because, in this uncertain world in which we live, the best that the purchasing specification can do is insure with some assigned probability that the accepted articles will meet the requirements of the ideal. Let us consider what happens in the absence of an ideal or design specification.

Some years ago I was in charge of a group of metal shops that made piece parts for artillery fuzes. One of my jobs was to make a mechanism which, if manufactured according to the specification, should not function under an applied load of L_1 pounds (for safety reasons) but should function with certainty under an applied load of L_2 pounds. The acceptance test consisted of firing a small sample of fuzes in normal gun fire. Failures were occurring both in the tests of the mechanisms to function properly for the tolerance range L_1 to L_2 and in the ballistic firings of the completed fuzes. The shops were in the usual state of confusion that accompanies a trouble for which one cannot find the cause. A brief examination of the physics involved showed that a much greater tolerance range than L_1 to L_2 could actually be allowed. Therefore I asked the engineering staff who wrote the specification to please relate the history of the case. They stated that they realized initially that a large tolerance range, say L_7 to L_8 could be allowed; but since they felt that the allowable tolerance range was greater than necessary, and since they feared that violations of the specification limits would occur, they allowed initially only a smaller tolerance range, say L_5 to L_6. Subsequently trouble occurred, so, to tighten up on quality, they cut the tolerance range to new limits, say L_3 to L_4. Trouble occurred again and they cut the tolerance range to the still closer limits of L_1 to L_2. They admitted that there was not much logic in specifying super quality with the hope that perhaps a slight improvement in a much poorer existing quality would result. What really happened was that unrealistic specification limits led to unrealistic methods of testing; unrealistic methods of testing led to poor manufacture; and finally poor manufacture led to a product which did not meet even the broad tolerance range which could be allowed under the physical laws which governed the functioning of the mechanism. With this understanding of the problem, and the use of statistical methods, it was easy to put in a quality control method of testing which insured with a high degree of probability that the mechanism would function properly.

The engineering department had a clear enough basis for a design specification. They did not use it. They followed the customary procedure of choosing arbitrarily small tolerance limits, and prescribing that a small sample should be taken from each batch and that none should fail to meet tolerance requirements. If they had used information as a basis for describing clearly what they wanted and for writing an acceptance test procedure which would insure with high probability a satisfactory quality level for the accepted product, they would have procured a cheaper product and have avoided the successive troubles which they attempted to remedy in the wrong way.

Quality Determination

I shall not attempt to describe in detail the technical aspects of the statistical methods for quality determination. These are amply covered in such literature as the American Standards Z1.1, Z1.2, and Z1.3. Instead I shall attempt to show the way in which the techniques operate, the savings which they effect, and the choices of methods which are available. Let us assume that we have determined what quality we want. The next step is not describing that quality, for the vendor may not be vitally concerned about what we want, but of *describing clearly what acceptance tests we shall perform upon the vendors' product* in order to assure with some degree of probability that the product will meet the ideals of the quality which we want. It is these tests which really put teeth into the specification and make it binding.

Quality control is essentially a method of process inspection which, over a period of time, indicates the general level of quality and detects changes in quality when they occur. This procedure can be used as an acceptance technique with one important change: instead of heeding an indicated change in quality as an evidence of trouble in the process and doing something to correct the process, we take the indicated change in quality as evidence for rejecting the vendor's product, subjecting his product to very scrupulous inspection, or otherwise insuring the quality of the questionable portion of the product. A quality control procedure can be written into a purchasing specification in such a conventional and straightforward manner that only a statistician would know that the specification was predicated on sound quality control principles. These procedures are described in detail in Shewhart's original book[4] on the subject, in the publications of the American Standards Assn., and elsewhere. I have described their application to specifications in two

[3] Walter A. Shewhart, "Some Aspects of Quality Control," *Mechanical Engineering*, December, 1934.

[4] Walter A. Shewhart, "Economic Control of Quality of Manufactured Product," D. Van Nostrand and Co., Inc., New York, N. Y. (1931).

previous publications.[5] I believe that you would be more interested in hearing how a single application of this technique to specifications for armor plate saved the government millions of dollars during the war.

Quality Control Specifications for Armor Plate

In the beginning of the war, current specifications for tank armor were of the conventional type and required that samples of armor plate be tested by firing at the plate with armor-piercing projectiles in a prescribed manner, and that none should fail. Armor plate was being destroyed in testing at Aberdeen Proving Ground at a rate sufficient to make a very large number of tanks per year, and the Chief of Ordnance desired that the principles of quality control be applied to the acceptance testing of armor-plate testing as a method of quality determination in order to conserve this product, reduce the cost of acceptance testing, and improve the quality of the plate. I asked to be excused from responsibility for this assignment on the grounds that statistical knowledge was insufficient qualification for the task because it required also a knowledge of metallurgy and other engineering principles involved in the tests. However, I collaborated with Edward M. Schrock in designing the acceptance procedure which was finally adopted.

It turned out that there were no technical or engineering difficulties to prohibit a straightforward application of quality control techniques. However, the exigencies of war presented a serious and unusual problem. Retesting could serve no useful purpose. Sorting by 100 per cent inspection was impossible because the test was destructive. In short, there was no way to penalize a manufacturer financially for his bad product, but we thought of a way which was probably more effective even than financial penalties. It was decided to reject no product on a basis of the quality control technique. Instead, the old specifications were kept in their entirety, even though they required much more testing than was necessary if a manufacturer made good armor plate with a controlled process. A few words were merely added to each of the specifications to the effect that if a manufacturer had thirty-two consecutive tests or eight averages of four items each (representing thirty-two lots) which fell between certain limits (the limits were predicated upon probabilities derived from quality control procedures), his acceptance samples were cut to one third. If the next sixteen tests or four averages based on four items each fell within limits, the manufacturer's acceptance samples were cut to one sixth the initial amount. These cuts in sample size were highly justifiable because, if a manufacturer has been producing satisfactory quality over a period of time with no change in the quality level, it takes less evidence to assure one of his quality than that required of a manufacturer who jumps his quality about from time to time. This procedure was very effective even though it did not directly penalize the vendor. If several vendors accepted contracts for a certain type of armor plate, and after a period of time some of them went on the reduced sampling basis, but one or more others were required to stay on the standard sampling basis, the presidents of the companies who failed to gain the favored status would come to Aberdeen at once to find out why their product was regarded more critically than that of their competitors. Quality control charts showed clearly the situation and the companies often identified the causes for variation in their product, corrected the causes, and improved the product. The vendors even wrote letters of thanks to Aberdeen Proving Ground in appreciation of having the variations in their product called to their attention thereby enabling the vendors to manufacture a better and more economical product. This procedure was operated by the Ordnance Department during almost the entire war and it saved the Government approximately four fifths of the total number of samples (amounting to hundreds of tanks) that would have been used under the conventional type of specification, the corresponding testing effort, and consistently assured a much better product than could have been hoped for under the conventional type of specification. The improvements occurred even during a period of shortages of alloying materials, and quality was kept up so well that the Director of the Metallurgical Laboratory at Watertown Arsenal was led to remark that we would continue to have good armor plate if we just did not run out of water in which to quench it. Of course, we must recognize the work in research and development by the metallurgist at Watertown Arsenal, in plants producing armor, and at research agencies working under the direction of N. D. R. C.

Distinction Between Design Specification and Inspection Specification

It will facilitate the remainder of the discussion, if at this point a check is made on just what has been discussed so far. It has been pointed out that the first step in the writing of a specification should consist of thinking out clearly just what one wants. A description of this desired quality shows clearly the end toward which one intends to work. It is a goal and not a quality mark which one can reasonably expect to meet 100 per cent of the time. In fact, the heart and soul of economic specification consists of accepting a calculated risk that the accepted product will not meet the quality goal. Whether one publishes this design specification is unimportant. The important thing is the writing of an economic inspection or acceptance specification which the design specification makes possible. The inspection specification has one function only, and that is to describe *the quantity* and *kind of evidence* which will be accepted as satisfactory proof that the product will meet the design specification. The unwritten (or not published) specification describes a goal; the written specification describes a basis for judging whether the product will meet that goal. The second specification differs from the usual

[5] Leslie E. Simon, "An Engineers' Manual of Statistical Methods," John Wiley and Sons, New York, N. Y., (1941). Leslie E. Simon, "Contribution of Statistics to the Development and Use of Purchasing Specifications and Standards of Quality," University of Pennsylvania, 1940. Reprinted Army Ordnance, March–April 1941.

100 per cent conformance specification chiefly in that it describes an inspection and sampling procedure which is calculated by means of statistical methods to yield a high probability (less than certainty) that the product will meet the goal of the design specification.

Only one basis for writing the acceptance specification has been discussed; namely, the use of the quality control technique as a quality determination procedure. It should be noted that the use of this procedure involves certain limitations. Its most stringent limitation consists of the requirement of order, that is, the samples must be taken in the order of production. It has great advantages in economy and is especially useful where the inspection or testing method is destructive, but it should be clear from the example which has been given that the quality control procedure really does not yield much information about the discrete batches of product which are presented for inspection; its most valuable information refers to the quality of the aggregate of all the batches. It yields an assurance that the whole flow of product from a manufacturer will, with some calculated risk, meet the ideal of the design specification. *It samples the process rather than the product.*

Single and Double Sampling Techniques

It is obvious that the quality control technique works ideally when a single consumer is accepting the entire output of a producer, or at least when successive lots or batches come from the same producers. It is not a *screening* technique for distinguishing between good and bad lots of product offered by various vendors. However, there are many strings to the statistical bow and I would like to give you an example of how our Government saved many millions of dollars during this war by the use of statistical screening techniques. By way of preliminary explanation, let us suppose that a manufacturer is offering piece parts for acceptance in lots or batches. Let us further suppose that by inspection a part can be classified as good or bad, as defective or not defective, as conforming or not conforming. Suppose further that some degree of defectiveness can be tolerated—for example, 1 per cent. It is easy to see that a sampling table can be drawn up somewhat thus: out of a lot of 1000 pieces take a sample of 50. If the number of defectives is 0 or 1 the lot will be accepted; if the number of defectives is greater than 3 the lot will be rejected. However, if the number of defectives is 2 or 3 a second sample of 100 shall be taken and the total number of defectives in the two samples combined (150 items) shall not exceed 3. The common sense of the procedure is obvious. If the lot of articles is very good or very bad, the first small sample gives sufficient evidence for identifying its quality. If, however, the lot of articles is of marginal quality, a larger sample is necessary for the finer degree of distinction.

As war production got under way, the Ordnance Department was faced with a perfectly enormous acceptance program. It was necessary that all vendors be treated fairly and alike; it was necessary to get enormous quantities of ordnance matériel quickly; and finally it was necessary that arms and ammunition be reliable and safe. Here was a sampling problem of unprecedented scale. Here, if ever, was an opportunity for dollars for your thoughts.

Factors Affecting Choice of Technique

Since the quality control technique had already worked well in several acceptance sampling procedures, it might have been possible to convince the Ordnance Department that it should apply this method to all acceptance inspection or even that it should go a full step further and require statistical quality control of its contractors. Although these more drastic steps offer great economy and efficiency, neither of them would have been wise, at the time.

An attempt to require statistical quality control of manufacturers, although ideal, would surely look like discrimination, and bring a storm of protest. There were certainly not enough quality control engineers in the country to administer quality control, even if it were already running. Finally, statistical quality control has no place in production until at least a reasonably good state of engineering control has been attained, and many of the new manufacturers were doing well to produce at all. To have advocated quality control in process would have been very detrimental to its orderly introduction in American industry, and would not have helped acceptance inspection.

The use of the quality control technique for quality determination likewise seemed unpromising. There were two major difficulties. First, it would be almost impossible to meet the requirement regarding the selection of samples in order of production. This requirement is not so exacting with respect to a major item like armor plate or even completed lots of mechanical time fuzes, but if it were extended to all the manufacturers of all sorts of piece parts, each with his idiosyncrasies of production, it would be impossible to secure an adequate number of qualified inspectors. The second difficulty lay in the fact that the quality control technique results in sampling the production process rather than the units of product. It was known that quite too many of the production processes were unsatisfactory.

Hence, there was an obvious requirement for an efficient screening process. It was expected that the statistical screening process would (1) keep out most of the bad parts; (2) make available most of the good product even though much of it came from manufacturers who produced a considerable amount of faulty product, and (3) stimulate improvements in quality because the vendor would know that the degree to which he met the specification was being checked in an efficient, fair, and operationally verifiable way.

The single and double sampling inspection table by Dodge and Romig[6] (not then published as a book) offered good initial material for the design of inspection procedures. However, it is seldom that existing procedures cover all of one's requirements; and upon consultation between the representa-

[6] H. F. Dodge and H. G. Romig, "Sampling Inspection Tables," John Wiley and Sons, New York, N. Y. (1944).

tives of Ordnance and the Bell Telephone Laboratories, it was finally decided to get out entirely new tables specially designed to meet the task.

These tables were designed so that it was very simple for an inspector to do an efficient job, even when lots or batch sizes varied greatly. Furthermore, the procedures were so marked that Ordnance could always know the level of quality of product which it was getting and approximately the probability that the product would meet the requirements of the design. It is important to note in this connection that the Ordnance Department actually set up *acceptable quality levels* for a great many items. The flexibility of the tables allowed the acceptance criteria to be varied in a reasonable way; for example, if a defect was of such a nature that it would be detected during assembly and a nondefective part could be easily substituted, acceptance criteria were liberal; if, on the other hand, the defective part were such that it would not be discovered until used in the field, acceptance requirements were much more rigorous.

The valuable contributions of the inspection acceptance sampling plans to quality and quantity of ammunition are well recognized today. Huge savings in materials which would otherwise have been rejected, man-hours in labor, dollars of cost, and even of lives on the battlefield are due at least in part to these improvements in acceptance techniques. However, the procedures which were used are common knowledge. They are available to all of us in books, pamphlets of the A.S.T.M. and the American Standards Assn., and in published articles. The huge savings were made possible because a small group of people chose to *think;* to (1) *determine what quality was wanted,* and (2) *to set about getting it by describing a sampling and inspection technique which would assure with an acceptable degree of probability that the product will have the quality wanted.*

Public Relations for Engineers

The following excerpts are from a recent letter from Vice-President Franklin Thomas of the American Society of Civil Engineers which was published in the February *Civil Engineering.* He was writing in connection with A.S.C.E. work on public relations.

". . . I am thoroughly convinced that it would be highly advantageous for engineers to be found more frequently in policy-forming groups and I am certain that such service by engineers would definitely be in the public interest.

". . . I . . . have come to a very definite conclusion that the most effective way for engineers to gain recognition for their profession and opportunities for public service is through the activities of individual members of the profession who have all-round qualifications sufficiently well developed that they 'make their own way,' so to speak. I have observed repeatedly that where engineers have personal qualifications for acceptable social and personal relations with other men, associated with the intellectual abilities which we expect in successful engineers, their qualifications and usefulness are invariably recognized and they are given positions of responsibility and leadership.

"An inherent handicap to engineers in relation to other associations is the circumstance that many of the factors with which they work are material and inanimate, with definite properties, rather than personal and variable. Furthermore, the work of an engineer is often done in isolation, rather than in circumstances involving fresh contacts with human beings. These situations, accompanied by an indifference on the part of many engineers to a necessity to offset the conditions, result in the development of a type which has led to engineers being designated as 'God's frozen people.'

". . . Character and ability are the basic qualifications which engineers have to offer, but personality is the quality which will serve as the vehicle whereby the other qualities may be made effective and the usefulness of the individual very greatly enhanced.

"I have a very high regard for the value of engineers to society and for the service which they do and can render, but I know that the usefulness of engineers as a whole would be greatly enhanced if they as individuals were personally equipped to make themselves felt with their respective associations.

"There are two means whereby the influence of engineers in general upon society may be increased, aside from their technical accomplishments: *first,* by the abandonment among engineering students of the roughneck tradition of the typical engineer's character and a substitution of an elevated and broadened interest in the finer things of life, so that they can associate among gentlemen in a creditable manner; and *second,* that through initiative and direct effort they participate in the various opportunities generally available to become active in community life. . ."

Pressure Vessel Research

Announcement has been received of the inauguration of a comprehensive pressure vessel research program covering materials, design, fabrication, inspection and testing of unfired pressure vessels. This work, to be carried out by the Welding Research Council, is aimed to meet the need for quantitative data by those engaged in pressure vessel design and construction to insure sound design and reasonable life. The work will involve both carbon and alloy steels and of course will relate to the use of these materials in the larger and more complex designs of welded vessels.

Walter Samans of the Sun Oil Co., who is also chairman of the ASME Boiler Code subcommittee on unfired pressure vessels, is chairman of the committee in charge. The committee plans to employ a full-time secretary with headquarters in New York who would collect and maintain adequate records, correlate the projects approved, and in general aid in expediting the committee's work.

Steel Structural Shape Simplified Practice

Effective February 15, 1946, the National Bureau of Standards' Division of Simplified Practice promulgated a revised Simplified Practice Recommendation for structural steel shapes covering hot-rolled carbon steel material, identified as R216–46. Copies can be obtained from the office of the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

The recommendation, which had its beginning in a proposal of the Technical Committee on Carbon Steel Plate and Structural Shapes, of the American Iron and Steel Institute, is composed of 19 Tables and covers the nominal sizes, and weights per linear foot of wide-flange sections, light beams, stanchions, joists, standard-beams, H-beams, wide-flange bearing piles, channels, and tees, with angles being shown in thicknesses. Sections and angles used in carbuilding and shipbuilding are also included.

The declared purpose of the program is to eliminate avoidable waste through identification of those varieties of structural steel shapes that have the greatest usage. General adherence to the simplified list should result in tangible advantages to manufacturers, distributors and users alike.

The Spectrochemical Analysis of Steels with a Direct-Reading Instrument

By M. F. Hasler[1], J. W. Kemp[1], and H. W. Dietert[2]

THE direct-reading spectrochemical analysis of low-alloy steels is now a completely accomplished fact. Practically every phase of steel testing from residual impurity measurements to alloying constituent determinations can be handled by the instruments to be described, at the rate of from 1 to 2 min. per sample. This represents a considerable saving of time over the standard spectrographic method, which in turn saved time over the methods it displaced. The results obtained with a commercially available direct-reading instrument, known as the Quantometer, indicate that it is practical to apply this type of instrumentation to the routine control analysis of steel, and, as a corollary, to the analysis of other metals and alloys.

The Analytical Problem

Before discussing the specific instrumentation employed, it will be well to review the problem involved. It is a rather well-known fact that carbon and sulfur cannot be determined successfully by ordinary spectrographic methods, while phosphorus can only be determined under special conditions. However, all the alloying elements such as manganese, nickel, chromium, molybdenum, silicon, copper, vanadium, cobalt, titanium, aluminum, and zirconium and the detrimental elements like tin, lead, arsenic, antimony, and bismuth can be determined by spectrographic methods. Essentially the same limitations exist for the direct-reading instrument that exist for the spectrograph, as in principle the two are identical—the photographic emulsion of the spectrographic method having been replaced by multiplier phototubes in the direct-reading method.

In deciding which elements of this group should be investigated, the most important residuals and alloying elements have been chosen as shown in Table I. The methods worked out adequately cover the ranges indicated for most of the elements.

TABLE I.—RANGES OF PERCENTAGES SIGNIFICANT IN STEEL PRODUCT TESTING.

Element	Refining of Steel, Residual Work	Low-Alloy Steel
Manganese....	0.05 to 1.0	0.2 to 2.0
Nickel........	0.03 to 1.0	0.3 to 4.0
Chromium.....	0.05 to 1.0	0.3 to 2.0
Molybdenum..	0.01 to 0.3	0.15 to 1.0
Vanadium.....	0.01 to 0.3	0.05 to 0.3
Silicon........	0.05 to 0.6	0.15 to 0.75
Copper........	0.05 to 0.5	0.05 to 0.5
Tin...........	0.01 to 0.3	0.01 to 0.05

Description of Necessary Instrumentation

The direct-reading installation consists of three parts: a special spectrometer containing up to twelve light receivers; a recording console which has a recorder for each receiver; and a source unit providing the means for exciting a high intensity spectrum of the sample to be analyzed under a variety of excitation conditions. Such an installation is shown in Fig. 1, the spectrometer at the right, and the recording console at the left. The source unit is beyond the picture at the right.

The grating spectrometer is not a redesigned spectrograph but is an entirely new instrument equipped with tracks on which twelve receivers can be moved to different positions along the spectrum. These receivers are arranged in three groups of four each in such a manner that the four receivers in a group can pass by each other without mechanical interference and with very little optical interference. This system allows lines quite close together in the spectrum to be measured at the same time. The actual system is set up by adjusting each receiver so that it receives light from a single spectrum line of each of the elements to be determined. One or more of the receivers are adjusted to receive light from certain iron lines. These are used for internal control purposes. All receivers remain stationary once their positions have been determined to cover

Fig. 1.—The Direct-Reading Installation in Use.

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[1] Director of Research and Development, and Research Supervisor, respectively, Applied Research Laboratories, Glendale, Calif.

[2] President, Harry W. Dietert Co., Detroit, Mich.

the required problems of the control laboratory.

The recording console possesses a recorder for each receiver, on which the integrated intensity of the spectrum line on which the receiver is focused is measured. The total time of recording is controlled by one of the receivers obtaining light from an iron line. In this way the usual "internal standard method" with all its advantages is adopted for use with the direct-reading instrument. However, as used in the Quantometer, it is refined in that a definite value of the total integrated intensity of the controlling iron line is used as the control rather than the measured value as obtained over a constant time as used in spectrographic work. By this simple procedure and the use of printed tapes on each recorder, the instrument is made to read directly in percentage composition of each of the elements to be determined, without calculations of any sort. Besides the recorders, the console is equipped with tapped sensitivity controls, which allow rapid adjustment of the readings of the recorders so that standardization can be readily effected. This is done by the simple procedure of analyzing standard samples. Since this can be done so rapidly, it becomes feasible to standardize the instrument once every half hour or less if need be. The recording console also houses the various power supplies. To insure against part failure and consequent work stoppage, the multiple-channel principle is used throughout. Thus separate low-voltage power supplies are used for each receiver and separate high-voltage power supplies for each four receivers. These, with the separate sensitivity controls and recorders for each receiver, furnish a number of units of each subassembly, which makes interchange of components entirely feasible should trouble develop. As a further aid to this process, all subassemblies are connected into the circuit through aircraft-type plug connectors. Thus by providing one or two spare channels, it is a relatively simple matter to change connectors and work around the part giving trouble. Subassemblies can be readily removed for repair, or for return to the factory for replacement.

The source unit used with the Quantometer differs from conventional source units chiefly in two respects; first it allows for higher intrinsic intensity in each stroke of the discharge, and, second, it allows for a higher number of strokes per second than is usual. It is also provided with an electrically operated change-over switch, so that two entirely different types of discharge may be used in rapid succession. This allows the analysis of a steel sample under conditions of superior accuracy where elements in the range from 0.1 to 5 per cent are being considered, or under conditions of superior sensitivity where elements in the range 0.01 to 0.1 per cent are involved. Other manual switching is provided on the source unit, so that in the case of special problems the same spectrum line of an element can be used over a wide range of percentages by employing a variety of discharge conditions. This last feature is an important one for the Quantometer, as the number of lines available for a certain setup of the unit is limited to the total number of receivers which are available—twelve in number. All of the above points will be considered in more detail when the actual analyses are discussed.

In an earlier paper the authors[3] described in detail the limitations which they expected a direct-reading instrument would have if applied to steel analysis. These limitations had to do with the ability of the instrument to separate element lines from the complex iron spectrum and to measure very low percentages. Both these features are controlled by the widths of the receiver and primary slits that it is practical to use. In the previous work, a receiver slit of 0.3 mm. was used which only allowed lines 2.1 Å or farther apart to be completely resolved. Since then by careful selection of multiplier phototubes and by improvements in the source unit, it is now possible to use receiver slits only one third as wide or 0.1 mm., with a primary slit of 0.05 mm. This allows the measurement of a line only 0.7 Å from another line without interference, when the 24,400 line per inch grating is used, and 0.5 Å with the 36,600 line per inch grating. It also allows the measurement of residual elements down to a lower limit, which is one

[3] M. F. Hasler and H. W. Dietert, "Direct Reading Instrument for Spectrochemical Analysis," *Journal*, Optical Soc. America, Vol. 34, pp. 751–758 (1944).

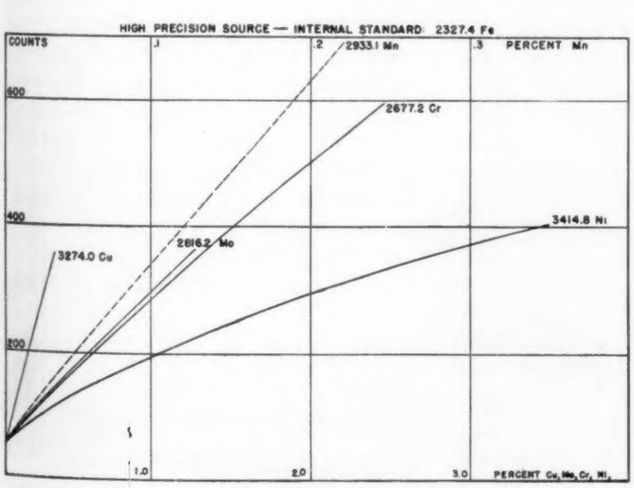

Fig. 2.—Working Curves for High Precision Source.

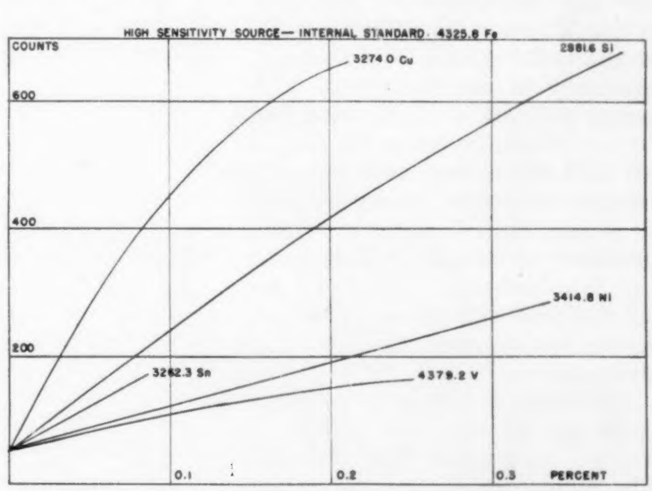

Fig. 3.—Working Curves for High Sensitivity Source.

TABLE II.—AVERAGE DEVIATION IN PERCENTAGE COMPOSITION.

High Precision Source—Internal Standard: 2327.4 Fe

Per Cent Determined	Deviations				
	Ni 3414.8 Å	Cr 2677.2 Å	Mn 2933.1 Å	Mo 2816.2 Å	Cu 3274.0 Å
4	0.036	0.043	....	....	....
2	0.019	0.022	0.022	0.029	....
1	0.010	0.012	0.011	0.016	....
0.8	0.009	0.010	0.009	0.013	....
0.4	0.005	0.006	0.004	0.008	0.005
0.2	0.004	0.004	0.002	0.006	0.003
0.1	0.003	0.003	0.001	0.004	0.002
0.04	0.002	0.002	0.0006	0.003	0.001
0.02	0.002	0.002	0.0004	0.003	0.0009
0.01	0.002	0.002	0.0003	....	0.0007

High Sensitivity Source—Internal Standard: 4325.8 Fe

Per Cent Determined	Deviations				
	Ni 3414.8 Å	Sn 3262.3 Å	V 4379.2 Å	Si 2881.6 Å	Cu 3274.0 Å
0.4	0.006	....	0.024	0.010	0.006
0.2	0.003	....	0.014	0.005	0.003
0.1	0.002	....	0.009	0.003	0.002
0.08	0.002	0.002	0.008	0.002	0.001
0.04	0.002	0.001	0.006	0.002	0.0008
0.02	0.001	0.0009	0.005	0.001	0.0005
0.01	0.001	0.0008	....	0.0008	0.0003
0.005	0.001	0.0007	....	0.0007	0.0002

third of the concentration that could be detected and measured previously with the wide slit. This threefold gain in resolution and sensitivity changes the picture for the application of the Quantometer to steel analysis from a possibility to a certainty.

Analytical Results

All of the results shown were obtained on flat specimens with a counter electrode of graphite. A standard Petrey stand was employed to hold the sample and electrode. A special brass block holder for the ½-in. Bureau of Standard steel standards was devised so that the flat ½-in. end area could be used for all calibrations. A 4-mm. gap and a 120-deg. cone on the graphite counter electrode complete the gap specifications. However, it should be mentioned that in order to assure the accuracy shown it was necessary to use the special high purity graphite electrodes produced by the National Carbon Co. and do all calibration and analyses with counter electrodes produced from a single 12-in. length of ¼-in. graphite. A two-jet air blast blowing the discharge away from the slit was used with the high precision source, but not with the high sensitivity source.

The working curves for the complete list of elements shown in Table I are given in Figs. 2 and 3. The counts recorded on the counters are shown at the left, while the percentage composition is indicated at the bottom. Both scales are linear. The curves of Fig. 2 are from results obtained with the high precision source, those of Fig. 3 were obtained with the high sensitivity source. It is from curves such as these that the printed tapes are made which allow the direct reading of analyses.

It will be noted that at zero per cent of all elements, a measurable count is obtained. This consists of two parts: (1) the electrical background or dark current of the multiplier phototube, and (2) the optical background present in the spectrum at the wave length considered. By adjusting the sensitivity of a receiver, any slope can be obtained for a working curve; however, the background count changes almost proportionately so that no gain in the real sensitivity of measurement results by such manipulation. In this case, for purposes of comparison, all the curves have had their slopes adjusted so that equal backgrounds are obtained. Plotted this way, it is apparent that if there is a similar error in measuring the background count of all elements, then an element which has a large slope to its curve can be measured to a lower percentage, with a certain degree of accuracy, than one with a small slope.

In actual practice the background-count error is not the same for all elements nor is the line-count error of the various elements the same. Thus no general statement can be made concerning precision *versus* percentage composition for a working curve of a particular slope. However, the general degree of precision to be expected is shown in Table II in which the average deviations actually obtained or calculated from those obtained are shown at various percentage compositions. As the background count is approached in a particular determination, the average error of determination becomes quite large. However, in the case of all of the determinations discussed, sufficient accuracy is maintained at all necessary levels for practical purposes. Table II also indicates the ranges of percentage composition investigated for the various elements.

Fortunately at high percentages both high precision and accuracy

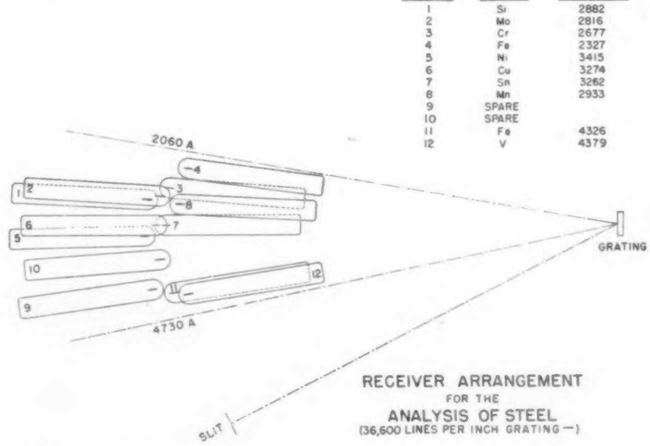

Fig. 4.—Receiver Arrangement for the Analysis of Steel.

can be obtained with the source unit employed. Long runs employing recalibration every half hour have shown that, in general, the maximum error (obtained on the average about once every fifty determinations) will not be greater than four times the average error. Thus a 1 per cent determination which shows an average deviation of 0.012 per cent should never deviate by more than 0.05 per cent if the equipment is working properly. Since it is a simple matter to perform duplicate or triplicate analyses in a very short time, these errors can be further reduced by averaging, should that be desirable.

Instrument Arrangement for Steel Analysis

In performing these analyses, ten receivers are employed, one on each of the eight element lines and two on iron reference lines. Thus in the case of a twelve-receiver spectrometer, two receivers with all of their associated equipment would be constantly available as standby capacity. This would insure continuity of analytical operations even under the most unusual cases of part failure. Figure 4 shows the arrangement of receivers employed for this type of steel analysis when a 36,600 line per inch grating is used in the Quantometer. This provides a dispersion of 4.6 Å per mm., a very high value for such a compact, mechanically stable instrument.

Conclusion

All of the above facts should make it apparent that a practical, adequately designed, direct-reading instrument can handle the very difficult assignment of steel analysis in a rapid and accurate manner. The fact that it has performed satisfactorily on this type of analysis which involves a complex spectrum and a large number of elements, many of which must be determined over wide ranges of percentage, indicates its suitability for a large segment of the field of metal analysis.

The Comprehensive Laboratory Testing of Instrument Lubricants[1]

By G. E. Barker, G. E. Alter, Jr., C. E. McKnight, J. R. McKlveen, and D. M. Hood[2]

The object of this paper is to describe the various laboratory tests employed during the investigation and development of new synthetic lubricants for fine instruments—a comprehensive research conducted during the past three years. These test procedures have been found extremely helpful in accelerating the preliminary determination of the value of oils for these specialized purposes. Of even greater importance is the fact that these laboratory determinations correlate very well with operational experiences.

It has been found that the following properties, which are among the most essential characteristics of a good instrument lubricant, are readily measured in the laboratory:

1. Viscosity,
2. Cloud and pour points,
3. Oxidation stability and corrosion of brass,
4. Corrosion and rusting of steel,
5. Evaporation,
6. Spreading, and
7. Coefficient of friction of steel on sapphire, lubricated.

In selecting, adapting, or evolving these tests two important conditions have been constantly emphasized. First, an effort has been made to keep small the volume of sample. If conducted in the proper sequence, the seven tests listed can be performed on a 1-oz. specimen. This fact is quite important, for instrument lubricants are always expensive and sometimes scarce. Secondly, careful consideration has been given to the simplicity of apparatus and procedure. Specialized equipment, other than that available in any well-equipped chemical laboratory, has been avoided wherever possible. For both evaporation measurement and coefficient of friction determination, however, special apparatus was designed and constructed because no adequate equipment could be purchased.

Viscosity

The viscosity is determined by A.S.T.M. Tentative Method of Test for Kinematic Viscosity (D 445 – 42 T),[3] using the modified Ostwald viscosimeters. The viscosities are routinely measured at 100, 32, and −40 F. Occasionally special determinations are made at −60 or −80 F. The low temperatures are obtained by placing a thermostatically controlled isopropanol bath in a low-temperature cabinet maintained about 5 F. below the desired bath temperature.

Cloud and Pour Points

The cloud and pour points are found by a modification of the A.S.T.M. Method of Test for Cloud and Pour Points (D 97 – 39),[4] in which a

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 250 S. Broad St., Philadelphia 2, Pa.

[1] Published by permission of the Navy Department.

[2] Multiple fellowship on special lubricants sustained at Mellon Institute by the Instruments Branch, Bureau of Aeronautics of the U. S. Navy Department. On this program see *Chemical and Engineering News*, Vol. 23, p. 524 (1945).

[3] 1944 Book of A.S.T.M. Standards, Part III, p. 1294.

[4] 1944 Book of A.S.T.M. Standards, Part III, p. 115.

16-mm. outside diameter test tube is substituted for the test jar, making it possible to run the tests on a 10-g. sample. In general, the cooling procedure of the standard method is followed; but, as most useful synthetic lubricants have very low cloud and pour points, the test tube containing the sample of lubricant and the thermometer is usually immersed directly in the cooling medium, which may be a mixture of solid carbon dioxide and any low-melting liquid (isopropanol, acetone, etc.).

Oxidation Stability and Brass Corrosion

In the preliminary evaluation of instrument lubricants there necessarily must be provision for determining the susceptibility to oxidation and the tendency to corrosion of the oils under examination. This need is particularly true in the case of synthetic lubricating materials for which there may be available no knowledge upon which to base an estimate of the effect of new compositions and possible impurities upon the properties of the lubricants.

Many of the methods set forth in the literature for determining the oxidation and corrosion properties of oils, either separately or together, have been designed especially for lubricants to be used in internal-combustion engines, and these methods, logically enough, attempt to duplicate the conditions encountered in such engines. None of these tests, therefore, was regarded as particularly well adapted to the examination of lubricants for fine mechanisms. There was required a rapid and simple test that would give some indication of the stability of the materials in the presence of atmospheric oxygen, catalyzing metallic surfaces, and traces of moisture. Important also was some means of determining quantitatively the effect of the oil itself or of any possible oxidation products upon carefully polished metal surfaces such as are found in instruments. Finally, it seemed essential to be able to obtain this information from very small samples. The test method described below was developed in an attempt to combine these requirements into one simple procedure that would enable a rapid and fairly indicative evaluation of the lubricants under study.

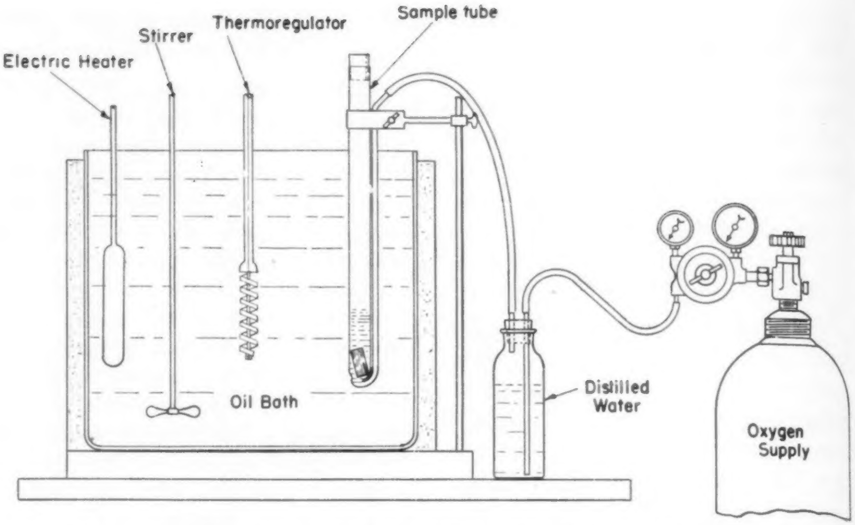

Fig. 1.—Apparatus for Determining Oxidation Stability and Brass Corrosion.

Preliminary Considerations:

There were several factors to which attention was given in setting the conditions of the test. First, it was regarded as essential that the oil sample be completely saturated with oxygen during the course of the test, for in some air-driven instruments, such as aircraft gyro instruments, there is prolonged contact between the lubricant and large quantities of atmospheric oxygen. Secondly, it was deemed advisable to use brass as the metallic material in the test because brass acts as an oxidation catalyst, is subject to corrosion by many organic materials, and is one of the metals commonly found in parts of small mechanisms. Finally, it seemed necessary to include traces of moisture in the test medium in order to simulate to some extent the conditions encountered in service in moist or humid climates.

Procedure:

The method consists of bubbling moist oxygen at atmospheric pressure through a sample of lubricant in contact with a polished brass surface. In order to accelerate the process and to reduce the time required, the test is run at 100 C. (±0.5 C.). The temperature is maintained constant by immersing the sample tubes in an electrically heated and thermostatically controlled oil bath (Fig. 1). Previous to its introduction into the sample, the oxygen is mixed with water vapor by being bubbled through a bottle containing distilled water at room temperature. The moist oxygen is then led down through the oil bath by means of a small tube that makes provision for pre-heating the gas, and is finally admitted to the bottom of the sample tube. A highly polished block of brass is contained in the tube in contact with the oil, and the moist oxygen is caused to bubble up past this block, thus bringing into intimate contact the sample of oil, the brass surface, and the mixture of oxygen and water vapor. Agitation is supplied by the bubbling action of the rising gas. Dust, atmospheric impurities, and oil vapor from the heating bath are prevented from entering the sample tube by inserting in the mouth of the tube a cork stopper that has had a narrow V-shaped groove cut along its length. The groove provides for escape of used oxygen to the atmosphere, but causes sufficient increase in the velocity of the escaping gas to prevent any vapors or particles from entering against the gas stream.

The procedure followed in running the oxidation-stability and brass-corrosion test is as follows: A small brass block, approximately 1 cm. square and 2.5 cm. long, is cleaned and polished with a series of metallographic emery papers, finishing with the No. 0000 grade. The block is then washed in a stream of water, swabbed with a piece of wet absorbent cotton, and dipped

several times into a beaker containing distilled water. From the distilled water the block is transferred by means of a small pair of forceps to a beaker containing ethyl alcohol (95 per cent) and thence to a beaker of benzene. Finally, the block is dried in an oven at 105 C. for 30 min., after which it is cooled in a desiccator.

After the brass block has been polished and cleaned, it is carefully weighed on an analytical balance and then placed in the bottom of one of the special test tubes (Fig. 2). Subsequently there is added 10 ml. of the oil to be tested, the viscosity of which has been determined at 100 F. (37.78 C.). A cork stopper, grooved as described, is fitted into the open end of the tube, and the tube itself is clamped in a vertical position with at least 18 cm. of its length immersed in the thermostatically controlled oil bath. A small neoprene tube connected to the moist oxygen supply is attached to the gas inlet tube, and the oxygen flow is so regulated that two or three bubbles per second (about 0.2 cu. ft. per hr.) rise through the sample of oil being tested. With the exception of periodic checks on the rate of oxygen flow, no further attention is required for the duration of the test.

At the end of 100 hr., the neoprene tube supplying oxygen is disconnected and the test tube is removed from the oil bath. After the outside of the tube has been cleaned and dried, the lubricant sample is carefully poured from the test tube into a small bottle in which it is kept pending a determination of its viscosity. The brass block is then removed from the tube and placed in a small beaker

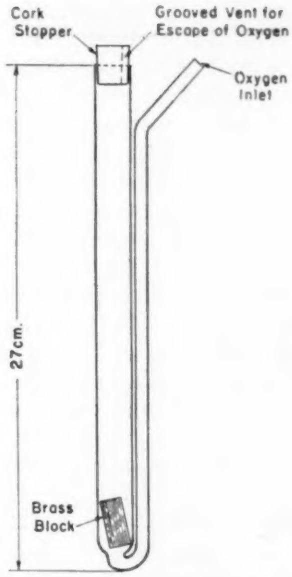

Fig. 2.—Tube Used in Oxidation and Corrosion Test.

of benzene. As before, the block is handled only by means of a pair of forceps. After having been rinsed by dipping several times in the benzene, the block is transferred to a beaker of alcohol, where the dipping process is repeated. Finally the block is dried in an oven at 105 C. for $^1/_2$ hr. and is cooled in a desiccator. Then, as prior to the test, the brass sample is carefully weighed, and the weight found after the test is compared with that previously determined. Likewise, the viscosity of the oil at 100 F. (37.78 C.) after the test is compared with the viscosity of the untested lubricant.

Examination of Results:

It has been found by experience that oils not unduly subject to oxidation and with little tendency to corrode brass never undergo more than a 5 per cent viscosity change during the test and never cause the brass block to lose more than 1 mg. in weight. These figures, therefore, have been set up in this laboratory as the standards to be met by a lubricant being subjected to the test. But practically any oil sample passing the test is able to meet these standards by a considerable margin, and, conversely, a sample that fails usually does so very definitely. In Table I are summarized the results obtained on four oil samples, of which two passed the test and two failed.

Conclusion:

It will be noticed that this test is in many respects similar to the original Indiana oxidation test (**1**)[5] for motor oils. The fundamental differences lie in the temperature to which the oil sample is heated and in the method by which the results are evaluated. It did not seem necessary to subject instrument lubricants to the high (172.2 C.) temperature used in the Indiana test to obtain correlations with conditions in the crankcase of an internal-combustion engine. Neither did it appear advisable, in view of the frequently small samples available, to try to measure the time required to reach some predetermined end point by periodically extracting and examining portions of the oil sample being tested. The advantages believed to be inherent in the present procedure for testing instrument lubricants are as follows:

1. The test provides, under conditions which are not too radically different from those which might be encountered in service, a fairly

[5] The boldface numbers in parentheses refer to the list of references appended to this paper.

TABLE I.—CORROSION OF BRASS BY LUBRICANTS.
Time of test, 100 hr., temperature, 212 F.

Lubricant	Weight of Brass Block		Change in Weight, g.	Viscosity of Oil at 100 F.		Appearance of Oil After Test	Appearance of Brass Block After Test
	After Test, g.	Before test, g.		Before Test, centistokes	After Test, centistokes		
Lubricant A (mineral oil, inhibited).....	17.7626	17.7626	0.0000	16.2	16.4	Somewhat darkened in color; otherwise unaffected	Unaffected
Lubricant B (synthetic)...........	18.3305	18.3305	0.0000	11.5	11.7	Slightly darkened, but still clear and without any trace of sludge or sediment	Slightly colored by an irridescent stain, but otherwise unaffected
Lubricant C (mineral oil, inhibited).....	19.0009	18.9940	+0.0069	10.3	11.3	Very dark. Considerable amount of sludge	Covered by a white deposit under which the surface was slightly pitted
Lubricant D (synthetic)...........	18.7613	18.8366	−0.0753	8.8	Undetermined	Dark green, opaque, and containing a large amount of sludge	Badly corroded and covered by a scaly surface film

rapid method of measuring the extent to which an oil is susceptible to oxidation.

2. The test gives an indication of the degree to which either the oil or its possible oxidation products are likely to affect the polished metal surfaces found in fine mechanisms.

3. The test serves as a foundation upon which may be based some conclusions regarding the heat stability of a lubricant at temperatures at least as high as any ever likely to be encountered in service.

4. The test permits the determination of these properties on comparatively small samples of materials which in many cases are either quite expensive or of very limited availability.

Corrosion and Rusting of Steel

Before lubricants may be considered for use in instruments, especially in ball bearings, they must pass tests which show that they do not promote corrosion of steel. It is also important in many cases that the lubricants actually inhibit steel corrosion, and hence tests must be made to evaluate their ability to act in such a beneficial way.

A sample of steel coated with a lubricant which does not protect against or which accelerates moisture corrosion, held at room temperature in air of 100 per cent relative humidity, will show signs of corrosion within a few days. In this simple test lubricants which are not corrosive may be left for weeks in contact with steel without showing any evidence of corrosion. In order to determine their relative ability to inhibit corrosion an accelerated test is employed.

A diversity of accelerated tests has been devised and a number of them have been reported in the literature. Humidity cabinets, water sprays, salt solutions, etc., are employed. Most tests of this type employ a steel test specimen in contact with water and the lubricant at an elevated temperature. A well-known and widely used test is the A.S.T.M. Tentative Method of Test for Rust-Preventing Characteristics of Steam-Turbine Oil in the Presence of Water (D 665 – 44 T).[6]

[6] 1944 Book of A.S.T.M. Standards, Part III, p. 1283.

Most of these tests are of utility in evaluating lubricants, but they require expensive equipment, involve complicated procedure, or call for such large amounts of lubricant that they are not practical for appraising small samples. The following procedure was designed to overcome many objections to the existing tests and yet make it possible for anyone to duplicate the conditions. Steel balls, of the type used in ball bearings, are employed as the test specimens; they are uniform in composition, convenient to work with, and need very little treatment to prepare them for use.

Test Procedure:

The test uses 15-ml. wide-mouth screw-cap bottles for containers and 0.5-in. steel balls as the test specimens. The balls are freed of the manufacturer's protective oil or grease coating by washing them in benzene or petroleum naphtha. They are then polished with a levigated alumina on a chamois in order to provide a fresh, clean surface. The alumina is removed by washing the balls in distilled water and swabbing with wet cotton. The washed balls are rinsed in ethyl alcohol and dried in an oven at 105 C.; they are then stored in a desiccator containing magnesium perchlorate until used.

A clean steel ball is placed in a test bottle and covered with 5 ml. of the lubricant. With the cap on, the bottle is suspended in an oil bath at 60 C. (±1 C.). After 1 hr. 5 ml. of distilled water is added, and the mixture is shaken and then allowed to separate into two phases. Usually the oil floats on the water in such a way that it is not in contact with the ball. If the oil is heavier than water and separates readily in such a manner that the ball is not in contact with the water, half of the oil is removed. The bottle is returned immediately to the oil bath.

An examination is made at intervals, and the condition of the ball and the appearance of the layers of oil and water are observed. The test is continued until at least one fourth of the surface of the ball is corroded or until a period of 500 hr. has elapsed. The test is then stopped. The time of testing and the condition of the oil, the water, and the ball are recorded. The ball is washed with a 1:1 mixture of benzene and isopropanol. It is then coated with a dilute collodion solution and filed for reference.

Discussion:

A lubricant with no ability to inhibit corrosion will permit the ball to corrode visibly in several hours. At the end of 24 hr. the ball will be badly corroded. The water will contain sediment, usually rust-colored but sometimes brown or black. If the composition of the lubricant is such that it is capable of preventing corrosion, there will be no change in the appearance of the steel ball for 500 hr. or more under the conditions of the test.

Occasionally, as a result of incomplete cleaning of the steel balls or of the containers, a test run on a rust-inhibiting lubricant will fail. For this reason, duplicate check runs are made on all samples which fail; and if neither sample corrodes, the lubricant is considered to have passed the test.

Tests have been run by this procedure on many of the materials commonly used as lubricants. Typical test data are presented in Table II.

TABLE II.—ACCELERATED RUST TEST DATA.

Lubricant	Duration of test, hr.	Condition at End of Test: Oil	Condition at End of Test: Water	Condition at End of Test: Ball
White mineral oil (U. S. P. liquid petrolatum, viscosity = 19 cs. at 100 F.)	24	Clear	Brown, rusty sediment	Rusted
White mineral oil + 1.0 per cent stearic acid	360	Clear yellow	Cloudy yellow-brown. Rusty sediment	Rusted
Commercial compounded lubricant containing rust inhibitor.	500	Clear	Clear	Unaffected

Evaporation

The rate of evaporation of lubricating oils for instruments was measured by bubbling nitrogen through a sample contained in a specially designed cell. This test was devised (1) to obtain results in less time than testing oil in service re-

quires, (2) to study the evaporative property separate from other characteristics, for example, oxidation, (3) to detect oils whose composition changes appreciably as evaporation proceeds, and (4) to arrange the oils in order of volatility. The test is an improved form of that devised by Barker and Urie (2); but the temperature of evaporation was 70 C. in the test described here.

It was desired that the test, in addition to fulfilling these requirements, yield reproducible, easily understood results and that it be simple but sufficient. Acceleration and a fair degree of precision were attained by causing the weight loss to approach closely the limit set by saturating the surrounding gas with oil vapor. Saturation also enables the findings to be expressed as percentage evaporated, as evaporation rate, or as vapor pressure, the first two of which are especially easy to comprehend. The use of nitrogen eliminates oxidation or other chemical action. A high rate of gas renewal compared to that found in most aircraft instruments shortens the test from months under service conditions to about ten days. A varying rate of evaporation indicates change of composition. Such a change reveals that, although the oil may meet specifications while it is in its original closed container, it begins to differ therefrom immediately on being used.

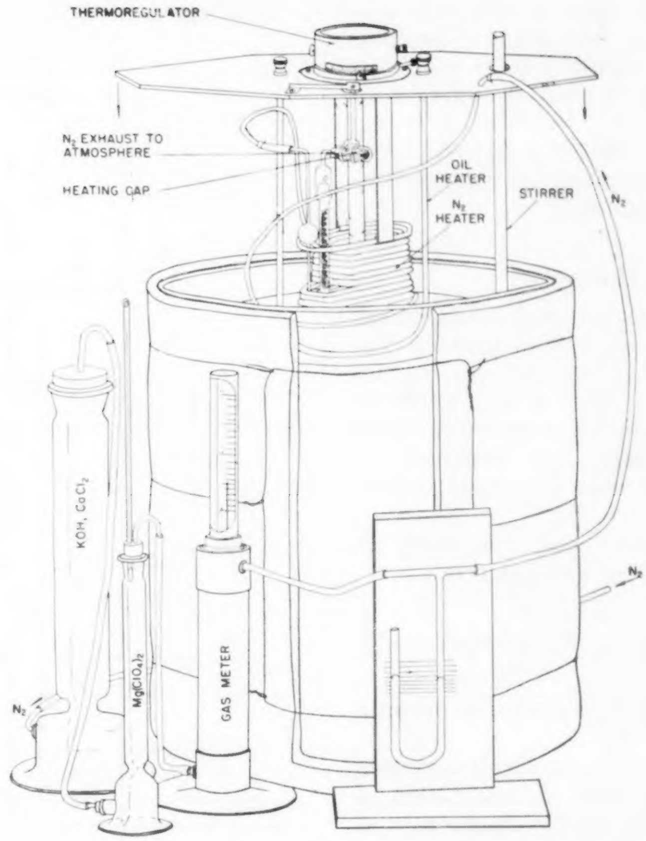

Fig. 4.—Evaporation Test Apparatus.

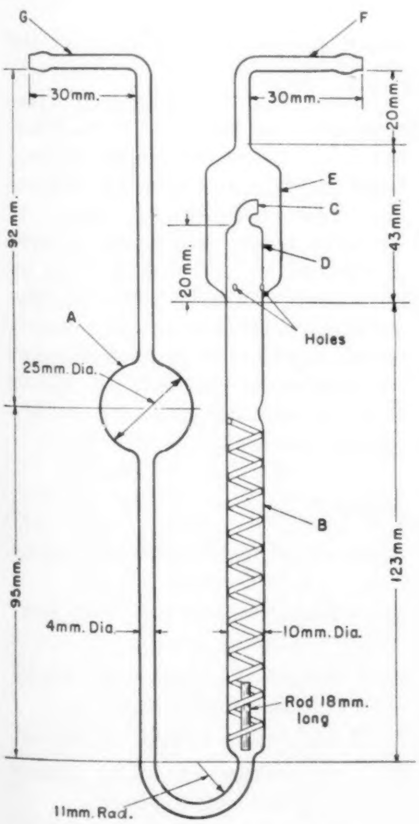

Fig. 3.—Evaporation Test Cell.

Apparatus:

The cell in which the sample is held for evaporation is shown in Fig. 3. The bulb *A* is a trap to prevent loss of oil if the gas flow should happen to reverse. The spiral in column *B* furnishes surface to saturate the nitrogen with oil vapor; the rod at the lower end is a safeguard against channeling. The inside cage *D* narrows down the column to the hook *C*, which, by increasing the gas velocity and directing the gas against the baffle *E*, generally prevents loss of unvaporized sample as entrainment or foaming through the top arm and exit *F*.

The accessory pieces of apparatus are related as shown in Fig. 4. Condensation in the top arm is prevented by a heating cap. The cap, which consists of a section of copper pipe, dips into the hot oil bath and conducts heat up over the arm, providing a heated region around this otherwise exposed part of the evaporation tube.

Procedure:

1. The evaporation tube is cleaned and weighed.
2. Into the receiving arm *G* is drawn 1 ± 0.2 g. of oil and the filled tube is weighed to 0.2 mg.
3. The tube with the sample is placed into the holder, which also serves as the nitrogen preheater.
4. The nitrogen connection is made (2-in. lengths of neoprene tubing); the top arm cap is put into place; and the apparatus is lowered into the thermostat.
5. The nitrogen flow is adjusted to 0.5 cu. ft. per hr. according to the flowmeter.
6. After a time interval (depending upon the volatility of the oil but usually not less than 18 hr.) the tube is removed, cleaned on the outside, and weighed. To avoid entrance of cleaning solvent into the evaporation tube appropriate precautions must be taken.

7. The tube is replaced and evaporation continued. The procedure is repeated daily until sufficient evaporation is adjudged to have occurred.

8. The results calculated from the data obtained are generally reported graphically.

Derivation of Equations:

It was thought that in instrument work the principle of plotting percentage of original sample remaining as a function of time would be more suitable than reporting vapor pressure only, and therefore results have been expressed accordingly.

The percentage of the sample remaining at any given time is

$$\frac{m_t}{m_0} \times 100 = N \qquad (1)$$

This value, N, is plotted as the ordinate.

The abscissa, or time expression, is derived from an adaptation of the equation used in the gas saturation method of determining vapor pressure. As the vapor pressure of the oil is low, the volume of vapor, v, is taken as that of the nitrogen alone (3):

$$M = \frac{(m_0 - m_t)RT}{pv} \qquad (2)$$

By correcting the experimental data to a set of "standards," the extent of evaporation may be revised for variations in sample size and gas rate. Let the standard sample size, m_s, be 1.0000 g. and the standard gas rate, q_s, be 25.0 liters per hr. (N.T.P.). Substituting in Eq. 2, which must be true for any sample size and for any gas rate (provided saturation is realized), we find

$$M = \frac{m_s(100 - N)RT}{100pq_st_s \times \dfrac{T}{273} \times \dfrac{760}{P}} \qquad (3)$$

Equation 2 must be true also for the conditions under which the experiment was run. Therefore,

$$M = \frac{m_0(100 - N)RT}{100\,pqt \times \dfrac{T}{273} \times \dfrac{760}{P}} \qquad (4)$$

Then, from Eqs. 3 and 4,

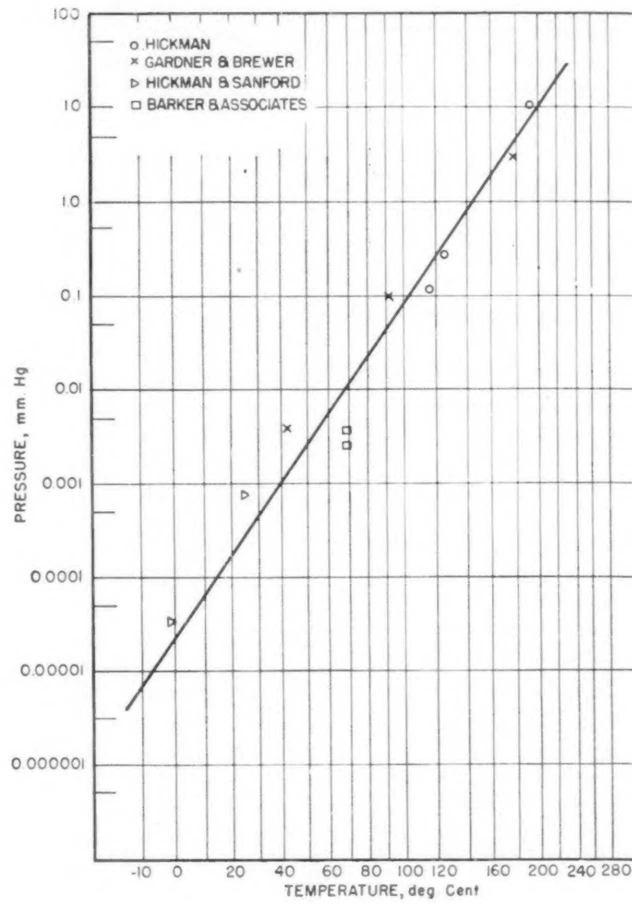

Fig. 5.—Vapor Pressure — Temperature Curve of Di-*n*-Butyl Phthalate.

$$\frac{q_st_s}{m_s} = \frac{qt}{m_0}, \text{ or } t_s = \frac{qtm_s}{q_sm_0} \qquad (5)$$

This value, t_s, is plotted as the abscissa. Under the following set of conditions, t_s represents an actual as well as a calculated value of time:

1. The composition of the oil remains constant during the test.
2. The initial sample is 1.0000 g.
3. The gas rate is 25 liters per hr. (N.T.P.).

If the oil composition remains unchanged during evaporation, Eq. 3 is the equation of the evaporation curve.

Results:

Comparison of the vapor pressures (0.00262 and 0.00385 mm. Hg for separate runs) found for di-*n*-butyl phthalate with other reported values (Figs. 5 and 6) shows that the apparatus described practically saturates the gas and thus gives results closely related to vapor pressure (see Fig. 5 for the comparison).

Curves E and F in Fig. 6 represent two runs on each of two different oils. These two curves, plotted from the data in Table III, indicate the reproducibility or degree of precision given by this test. Curve E exemplifies the results from an oil whose properties alter rapidly, as revealed by the changing slope—an oil expected to require frequent renewal in the instruments. Curve F shows results given by an improved lubricant.

Nomenclature:

m_0 = initial weight of experimental sample used,

m_s = initial weight of "standard" sample,

m_t = weight of experimental sample remaining at time t,

M = molecular weight of the oil,

N = percentage of initial sample remaining at time t,

p = vapor pressure of the oil,

TABLE III.—EVAPORATION TEST.

Point Number	Initial Sample Weight, m_0, g.	Elapsed Time, t, hr.	Observed Data: Weight of Tube and Sample, g.	Observed Data: Average Gas Rate (N.T.P.), R_a, cu. ft. per hr.	Calculated Data: Residue from Standard 1.0000-g. Sample, cg.	Calculated Data: Calculated Time, t_s, hr.
Oil E, Run 1						
			28.7385 (initial)			
1.........	0.8560	19.2	28.4197	0.94	62.8	23.9
2.........		24.1	28.3850	0.94	58.7	30.0
3.........		42.5	28.2774	0.94	46.2	52.8
4.........		47.9	28.2581	0.94	43.8	59.5
Oil E, Run 2						
			28.6124 (initial)			
1.........	0.7299	21.0	28.2590	0.94	51.6	30.6
2.........		41.8	28.1770	0.94	40.4	78.5
3.........		49.4	28.1582	0.94	37.8	85.0
4.........		66.2	28.1249	0.94	33.2	109.6
5.........		71.3	28.1158	0.94	32.0	117.0
Oil F, Run 1						
			28.9018 (initial)			
1.........	0.9528	19.0	28.8960	0.47	99.5	10.9
2.........		68.8	28.8918	0.47	99.0	39.6
3.........		94.2	28.8897	0.46	98.8	53.0
4.........		118.0	28.8878	0.48	98.6	69.2
5.........		141.8	28.8860	0.48	98.4	83.1
6.........		186.2	28.8838	0.46	98.2	104.8
7.........		234.0	28.8814	0.47	98.0	134.5
Oil F, Run 2						
			28.8286 (initial)			
1.........	0.8829	16.0	28.8241	0.47	99.5	9.6
2.........		87.8	28.8172	0.43	98.8	48.4
3.........		164.8	28.8103	0.45	97.9	95.1
4.........		207.5	28.8062	0.47	97.5	125.0
5.........		257.0	28.8015	0.47	97.0	155.0

P = total pressure under which the evaporation is carried out,

q = actual gas rate used in test; corrected to normal temperature and pressure,

q_s = gas rate used as "standard" for calculations,

R = gas constant,

t = time during which evaporation occurs,

t_s = calculated time of evaporation, and

T = temperature of oil and nitrogen in zone of contact.

Spreading

In the lubrication of pivot-type bearings, such as are found in clocks and watches and in some aircraft instruments, the tendency of the oil to spread is important. There are many ways to approach the problem of determining the spreading tendency of a lubricant. Other than testing in actual instruments, one of the best indications of nonspreading characteristics is obtained by measuring the contact angle between the lubricant and the solid surfaces to be lubricated. Theoretically, any contact angle greater than zero indicates that the liquid will not spread on the surface in question. Experience has shown that the greater the contact angle the less is the tendency of the liquid to spread. A contact angle of 5 to 10 deg. is probably sufficient to insure a nonspreading lubricant. The next most useful property in predicting the tendency of the lubricant to stay in the bearing is its surface tension. The greater the surface tension the less is the tendency for the oil to leave the bearing. Generally nonspreading oils have a minimum surface tension of 35 dynes per centimeter.

These tests give no evidence of the effect of aging of the oil or of changing the surfaces on the spreading tendency of the lubricant. To fill this gap in the test procedure, an "extended spreading test" has been introduced in which a drop of oil approximately 1 mm. in diameter is placed on a highly polished

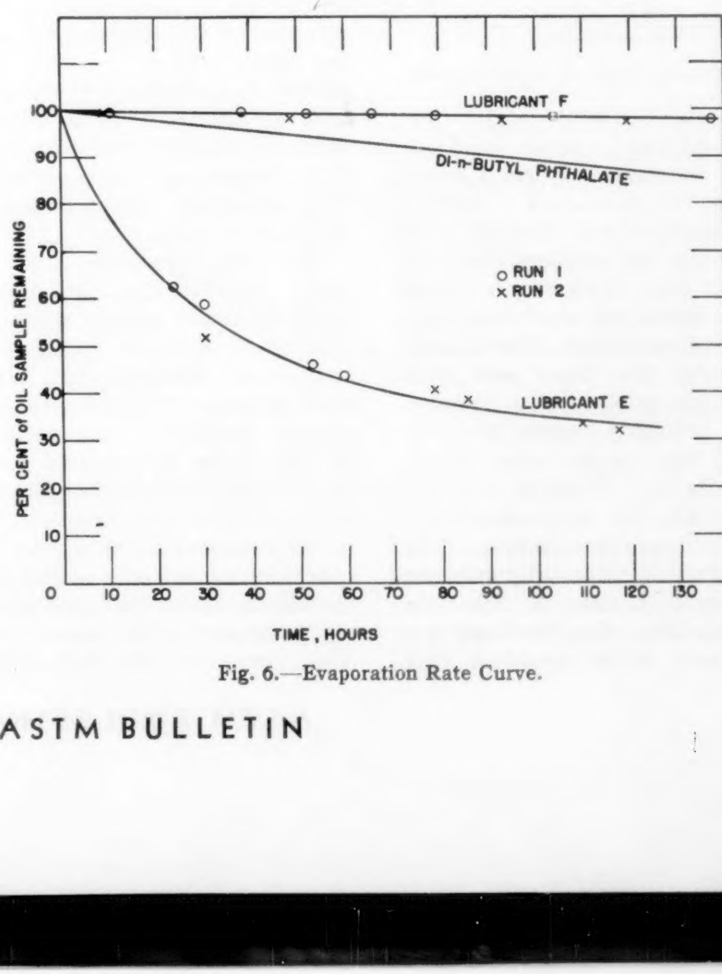

Fig. 6.—Evaporation Rate Curve.

steel surface and its change in diameter is measured periodically. One set of oil samples is maintained in an anhydrous atmosphere (in a desiccator with magnesium perchlorate) and a duplicate set is kept in a saturated atmosphere (enclosed in a container over water, but not immersed). In the saturated atmosphere condensation occurs on the steel surface and spreading commences in much less time than it does in dry air.

Experimental Procedure:

Contact Angle Measurement.—There are several methods of measuring contact angles of liquids on solid surfaces, but probably the most desirable procedure for the present problem is the measurement of the dimensions of a sessile drop on the surface in question (**2, 4, 5, 6, 7, 8**). The dimensions of the drop are determined by means of a low-power microscope equipped with a filar micrometer eyepiece. If the drops are small, their surfaces will be portions of spheres. Then angle θ, the contact angle, will be twice the angle BCD, which is $2 \tan^{-1} (BD/CD)$ (Fig. 7).

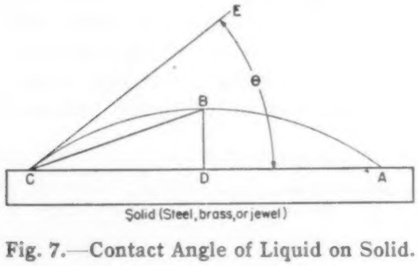

Fig. 7.—Contact Angle of Liquid on Solid.

The preparation of the solid surfaces is the most important factor involved in reproducing contact angle measurements. The materials used for the test surfaces consist of a piece of $\frac{3}{4}$-in. brass rod, a sample of $\frac{1}{2}$-in. hardened steel drill rod, and a synthetic ruby. The flat end surfaces of the brass and steel samples are polished with metallographic polishing papers Nos. 00, 000, and 0000, in the order named, and finally with Fisher's "Gamal" polishing alumina on a wheel covered with heavy broadcloth. The ruby surface is cleaned by rubbing with rouge on a chamois. After the final polishing, the surfaces are washed with water, swabbed with wet absorbent cotton, and rinsed thoroughly with distilled water. The samples are finally rinsed with acetone before drying for 15 min. in an oven at 105 C. The specimens are allowed to cool to room temperature in a desiccator containing anhydrous magnesium perchlorate.

The lubricant is dispensed from a microburette constructed for delivering reasonably uniform drops on the surface being used. With considerable experience, uniform drops of a liquid can be placed on a solid surface with an ordinary steel pen. Generally three drops of the liquid are put on each surface and an average of the contact angles is reported if the difference between any two on the same surface is not greater than 5 deg. If the difference is greater than 5 deg., the surface is cleaned and polished and the measurement is repeated. A drop of liquid 1 mm. across is a satisfactory size.

Extended Spreading Test.—This test is conducted on steel only but could be made on any solid. For this purpose, ½-in. steel rollers such as are commonly used in roller bearings may be employed as the surface specimens. One plane end of each roller is prepared exactly as the steel surface for contact angle measurements. One sample is placed in a desiccator (Fig. 8) and the other one is put in a closed vessel containing water to maintain the air saturated with water vapor. The diameter of the drop of liquid

TABLE IV.—CONTACT ANGLES OF LUBRICANTS.

Lubricant	Surface	Diameter of Drop, D, mm.	2 × Height of Drop, $2h$, mm.	$2h/D$	$\tan^{-1} 2h/D$	θ, deg.	
		0.828	0.167	0.202	11	22	
	Brass	0.886	0.189	0.214	12	24	23
		0.886	0.193	0.218	12	24	
		0.911	0.149	0.164	9	18	
N-22a	Steel	0.969	0.185	0.193	11	22	21
		0.976	0.189	0.194	11	22	
		1.050	0.224	0.213	12	24	
	Ruby	1.060	0.218	0.206	12	24	25
		1.170	0.289	0.247	14	28	
		0.928	0.160	0.173	10	20	
	Brass	0.851	0.144	0.169	10	20	22
		0.727	0.164	0.225	13	26	
		0.836	0.168	0.201	11	22	
Commercial watch oil "G"	Steel	0.791	0.140	0.177	10	20	21
		0.825	0.160	0.194	11	22	
		0.747	0.164	0.220	13	26	
	Ruby	0.767	0.176	0.229	13	26	26
		0.789	0.180	0.228	13	26	
		1.035	0.0967	0.0935	5	10	
	Brass	1.198	0.0934	0.0780	5	10	10
		1.221	0.1035	0.0845	5	10	
		1.261	0.0868	0.0686	4	8	
Commercial watch oil "H"	Steel	1.302	0.0900	0.0690	4	8	8
		0.988	0.0666	0.0678	4	8	
		1.000	0.260	0.260	15	30	
	Ruby	1.061	0.239	0.225	13	26	27
		1.080	0.243	0.225	13	26	

TABLE V.—EXTENDED SPREADING TEST ON STEEL.

Lubricant	Diameter of Drop, mm.		Time, days
	Anhydrous Atmosphere	Saturated Atmosphere	
N-22a	1.25	1.37	0
	1.55	3.0	123
	1.43	Spread	152
	2.23	.....	395
	Spread	.....	425
Commercial watch oil "G"	2.12	1.30	0
	2.08	1.29	124
	1.94	Spread	212
	2.05	....	755
N-32c	1.30	1.29	0
	1.44	Spread	150
	Spread	....	180

Fig. 8.—Extended Spreading Tests.

is measured periodically, usually once a month. This test is conducted only on those lubricants which have passed all other tests and are indicated to be nonspreading from contact-angle measurements.

Results of Typical Measurements:

Some typical measurements of contact angles are recorded in Table IV. Similarly, measurements as determined in the extended spreading test are presented in Table V.

Coefficient of Friction of Steel on Sapphire, Lubricated

Fine mechanisms which contain pivot-type bearings, such as are found in watches, clocks, and some aircraft instruments, are affected greatly in operation by the presence of friction. For this reason, extreme care is used in the design, material selection, and finish of pivot-type instrument bearings.

Because it is difficult to measure quantitatively the friction effect in an instrument, and as it is almost impossible to obtain an accurate representative value without making similar measurements on a large number of instruments, it was decided to design and construct a simple device for measuring the friction of two rubbing surfaces. A number of machines for measuring the effects of lubricants on the coefficient of friction under conditions of boundary lubrication have been described in the literature (**8, 9, 10, 11, 12, 13**).

Design of the Instrument:

After careful consideration of the characteristics of the previously described machines, it was decided to design and construct a pendulum type of instrument to measure the "oiliness" of lubricants. This type of machine was chosen because it makes available an oscillatory motion similar to that found in timepieces, the most numerous of the instruments containing lubricated pivot-type bearings. The design was developed to produce a linear speed between the bearing surfaces in the range encountered in the balance wheels of clocks and watches.

The theory of the measurement of friction by the damping of the oscillation of a pendulum is quite simple if the following assumptions are made:

1. That the normal force, F, on the bearing is not appreciably affected by the centrifugal force.
2. That the normal force, F, is not greatly dependent upon the amplitude.
3. That the damping effect by air resistance is negligible.
4. That the moment of friction, M, of the pendulum about its point of support may be considered constant.

Under these conditions,

$$M = WL\,\alpha_0$$

where:

W = weight of the pendulum,
L = distance of the center of gravity from the point of suspension of the pendulum, and
α_0 = decrease in the amplitude, α, brought about during one-quarter period by friction damping.

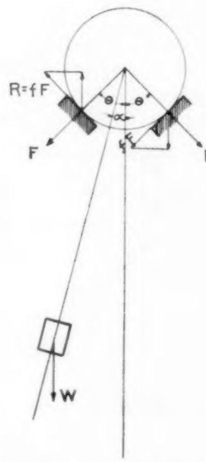

Fig. 9.—Schematic Diagram of Ball and Supporting Plane Surfaces.

Observing full periods, the value of the amplitude, A_n (radians), of the nth period is $A_0 - 4n\,\alpha_0$, where A_0 is the initial value of the amplitude and n is the number of full periods. Then

$$\alpha_0 = \frac{A_0 - A_n}{4n}$$

and

$$M = WL\left(\frac{A_0 - A_n}{4n}\right)$$

The force of friction on each plane surface is $R = f \times F$, where f is the coefficient of friction and F is the normal force on that surface (Fig. 9). Therefore

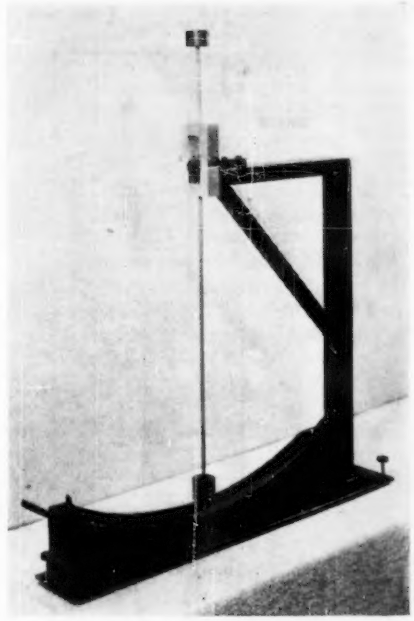

Fig. 10.—Pendulum for Measuring Oiliness.

$$F = \frac{W}{2}\left(\frac{1}{\cos\theta}\right)$$

and

$$R = fW/2\cos\theta$$

where θ is the angle between the vertical and the radius of the ball at its point of tangency with the plane bearing surface.

Then, since $M = 2(R\cdot r)$, where r is the radius of the ball:

$$M = \frac{frW}{\cos\theta} = LW\left(\frac{A_0 - A_n}{4n}\right)$$

and

$$f = \left(\frac{L\cos\theta}{r}\right)\frac{A_0 - A_n}{4n}$$

The constants for the particular instrument which was constructed are as follows:

L = 5.18 in.,
θ = 45, and
r = 0.250 in.

Substituting these values in the formula for the coefficient of friction,

$$f = \frac{(5.18)\ (0.7071)}{0.250}\left(\frac{A_0 - A_n}{4n}\right) = 14.64\left(\frac{A_0 - A_n}{4n}\right)$$

A general view of the instrument is reproduced in Fig. 10. The details of the pendulum and the sapphire bearing are given in Fig. 11.

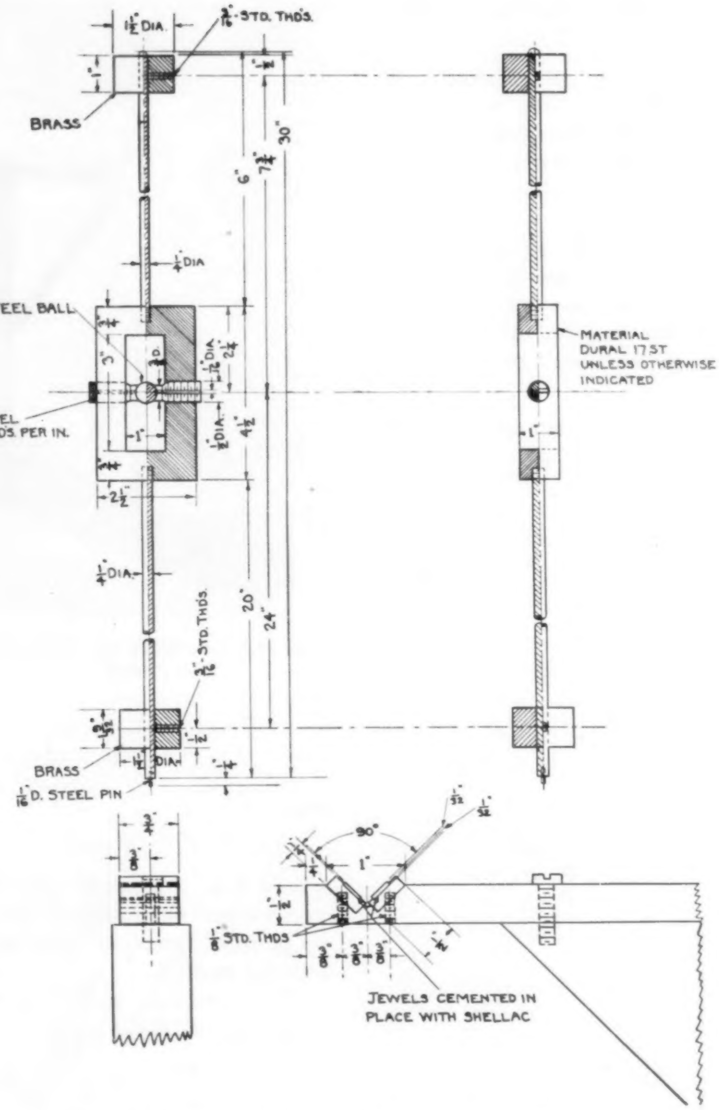

Fig. 11.—Detailed Drawing of Pendulum and Bearing.

Experimental Procedure:

It should be emphasized that measurements of oiliness are relative and that such determinations must be conducted under carefully controlled conditions.

The steel ball is prepared by washing with a suitable solvent to remove the previously tested lubricant, and polishing with rouge on moist chamois. The ball is washed with distilled water, swabbed with absorbent cotton, rinsed with alcohol or acetone, and dried for 15 min. at 105 C. before cooling in a desiccator. The plane (sapphire) bearing surfaces are prepared by washing with a suitable solvent to remove the previously tested lubricant and cleaning the surface by buffing with levigated alumina (Fisher's "Gamal") on moist chamois. The plates are washed with distilled water, swabbed with wet cotton, rinsed with alcohol or acetone, and dried for 15 min. at 105 C. before cooling in a desiccator. The surfaces of the cleaned steel ball and sapphire jewels are never allowed to come into contact with the fingers.

The lubricant is applied to the surface by transferring a few drops from the container to the jewels by a glass rod drawn to a point at one end. The drops of the lubricant are wiped over the surface by a piece of absorbent cellulose (such as "Kleenex"). The latter, which is now moist with the lubricant, is also wiped over the bearing surface of the steel ball. The pendulum is then suspended with the ball seated on the two sapphire jewels and measurements are begun by releasing the pendulum from any desired initial amplitude and observing successive amplitudes. It is most convenient to record the amplitude of every third swing. Tenths of a degree can be estimated on the scale. The average of five determinations is taken as the final value. Table VI contains the values of the coefficients of friction from some typical lubricants.

TABLE VI.—COEFFICIENTS OF FRICTION OF STEEL ON SAPPHIRE, LUBRICATED.

Lubricant	Swing Number	Amplitude of Swing (Average of five), deg.	Coef. of Friction
Light mineral oil..	0	25	
	3	19.8	0.1108
	6	14.7	0.1100
	9	9.6	0.1097
	12	4.4	0.1100
Castor oil........	0	25	
	3	21.6	0.0725
	6	18.2	0.0725
	9	15.0	0.0712
	12	11.8	0.0705
Porpoise jaw oil...	0	25	
	3	20.4	0.0980
	6	16.0	0.0959
	9	11.6	0.0954
	12	7.2	0.0950

Acknowledgments:

Many of the testing procedures studied and applied in this research were adopted during Mr. Barker's incumbency of the industrial fellowship supported in Mellon Institute by the Elgin National Watch Co.—a comprehensive project on synthetic watch lubricants that preceded and supplied basic guiding lights for the program of the Instruments Branch of the Bureau of Aeronautics. The authors are highly appreciative of the generous cooperation of the scientific staff of the Elgin National Watch Co. and of personnel of the Instruments Branch, Bureau of Aeronautics. The Aeronautic Instrument Section of the National Bureau of Standards has also been of material aid during the progress of the investigation.

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Electromagnetic Vibration Table

By R. K. Bernhard[1] and J. G. Barry[1]

Synopsis

The development discussed in this paper was for the purpose of providing equipment necessary for conducting a study of the effects of vibrations on airport pavement performance which is being conducted by Princeton University for the Technical Development Service of the Civil Aeronautics Administration. The general scope of this program and partial report on the progress made was presented in the Highway Research Board *Proceedings* (**1**).[2]

A vibration table to excite vertical and horizontal motions or a combination of both is described. The electromagnetic drive and the table platform, acting as a two-mass system, have been used for dynamic investigations and for the calibration of instruments. The electrical control facilitates an almost instantaneous change of displacement amplitude and frequency. Mechanical and optical controls allow a continuous double check of amplitudes within a range of 10^{-5} to 10^{-1} in., for the applied frequency spectrum from 7 to 200 cycles per sec., and of the wave shape. The interchangeable parts permit adaptation to various types of dynamic research.

Various types of vibration tables for testing and calibrating purposes exist. Mainly two systems are in general use, depending on the vibrating system.

The vibrating system may be of the one-mass type or of the two-mass type. For a one-mass system the coupling between the table and the driving mechanism must be rigid; for a two-mass system this coupling is loose. A rigid coupling forces the table to displacement amplitudes of the same magnitude as the exciter amplitude without any phase difference; a loose coupling may result in displacement amplitudes of different magnitude and shift in phase.

The driving mechanism can be mechanical or electrical. Mechanical drives of the excenter type (Scotch yokes) (**2**) represent a rigidly connected one-mass system; the main parts of the driving mechanism do not participate in the vibrations. Mechanical drives of the mechanical oscillator type (**3**) (unbalanced rotating masses) may be either a rigidly connected one-mass system or a loosely connected two-mass system. Electrical drives often equipped with electromagnets (**4**) can also be built as one-mass or as two-mass systems.

The selection of the proper type depends on the purpose of the vibration table. The main advantages and disadvantages of the various systems may be summarized as follows:

One-Mass System:

Advantages: Simple setup, no phase difference between displacement amplitude and exciter amplitude.

Disadvantages: Requires larger foundations to prevent energy losses.

Two-Mass System:

Advantages: Smaller foundations.

Disadvantages: Requires more rigid Excursion- and Phase-control.

Mechanical Drive:

(1) Excenter Drive.
  - Advantages: Simple setup.
  - Disadvantages: Limited to a lower frequency range; only slow change of amplitude and frequency possible.

(2) Mechanical-Oscillator Drive:
  - Advantages: Yields automatically sinusoidal vibrations.
  - Disadvantages: Limited to a medium frequency range.

(3) Electrical Drive (Electromagnetic):
  - Advantages: Widest frequency range, small wear, practically noiseless, almost instantaneous change of amplitude and frequency possible.
  - Disadvantages: Depends on transformation of electric power supply to required amplitude- and frequency range. Low frequencies are difficult to obtain.

Note.—Discussion of this paper is invited, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia 2, Pa.

[1] Consultant, Soil Mechanics Laboratory, and Assistant Professor of Electrical Engineering, respectively, Princeton University, Princeton, N. J.

[2] Boldface numbers in parentheses refer to the list of references appended to this paper.

Purpose

The special purpose of the vibration table is to test specimens subjected to mechanical vibrations and to calibrate instruments measuring mechanical vibrations. In general the excursions of the table may be vertical, horizontal, or a combination of both. Neither the magnitude of the required excursions nor the required frequency spectrum was known beforehand. The most economical system which used the least amount of essential material had to be selected.

A two-mass system with electromagnetic drive was chosen for the following reasons:

1. The table had to be installed on the ground floor of an old building which it was thought should not be subjected to appreciable mechanical vibrations. Thus practically no energy transmission through the foundation was permissible.

2. Sinusoidal vibrations were desirable in order to make all experiments easily reproducible.

3. The vibrating masses had to be changed considerably during one test and any readjustment of the air gap between magnet and armature due to changes in loading conditions had to be avoided as much as possible.

4. Long-time tests called for a minimum of wear.

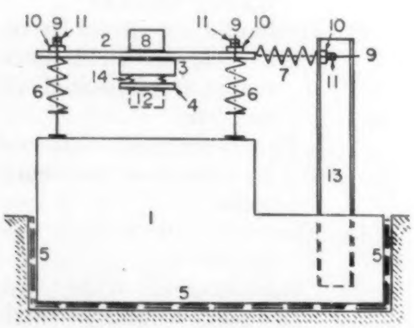

Fig. 1.—Diagram of Vibration Table. General Arrangement for Vertical Motion.

1. Foundation
2. Vibrating platform
3. and 4. Electromagnet
5. Insulation
6. Supporting springs for vertical motion
7. Supporting springs for horizontal motion
8. Test specimen to be vibrated or instrument to be calibrated
9. Anchor bolts
10. Rubber dampers
11. Locknuts
12. Additional weights for adjustment
13. Vertical post
14. Springs and dampers between magnet and armature

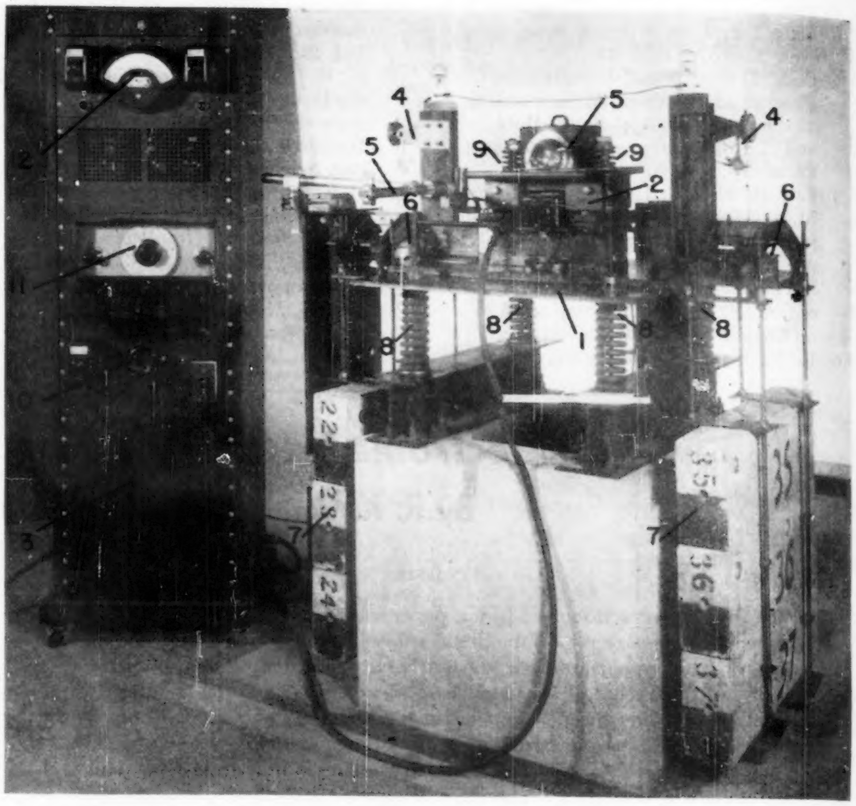

Fig. 2.—Dynamic Consolidation Soil Test on Vibration Table, Setup for Vertical Motion.

1. Vibrating platform
2. Electromagnet
3. Electrical control cabinet
4. Mechanical controls
5. Optical control
6. Container for soil specimen
7. Loading weights
8. Platform springs
9. Magnet springs
10. Rheostat for amplitude control
11. Oscillator for frequency control
12. Ammeter for displacement indicator

5. Office space in the second story of the building required almost noiseless operation.

General Arrangement

The vibration table consists of three main parts, the foundation, the vibrating platform, and the exciter (see Figs. 1 and 2).

Foundation.—A reinforced concrete block, weighing approximately 15,000 lb., is insulated from the surrounding soil and the floor by means of cork and rubber mats. This block can be considered to remain at rest, that is, for all practicable purposes does not participate in any vibrations. Two horizontal H-beams on top of this block serve as support for a set of four vertical helical springs to allow for vertical motion of the platform. Two vertical H-beams, partially embedded in the concrete block, serve as support for a second set of horizontal helical springs to allow for horizontal motions of the platform. Threaded bolts with double nuts permit prestressing the springs, and rubber dampers, which are sandwiched between the nuts and the vibrating platform.

Vibrating Platform.—A 30 by 30-in. steel plate is supported by the helical springs. The first and second sets of springs (*6* and *7* of Fig. 1), with a low spring constant, connect the vibrating platform, including the electromagnet, with the concrete block. A third set of springs (*14* of Fig. 1), with high spring constant, connects the vibrating platform electromagnet with the armature of the electromagnet. All sets of springs and the corresponding sets of dampers are interchangeable. Furthermore, the effective mass of the armature can be increased by additional weights. Hence the natural frequency ratio of the system: Platform-foundation, to the system: armature-electromagnet, that is, the resultant coupled vibrations can be controlled.

The adjustment of spring constant, damping, and mass-ratio facilitates the application of displacement-amplitudes within a wide

range of magnitude and frequency and allows the excitation of purely sinusoidal motion if so required.

Exciter.—The exciter is a commercially available vibrator (**5**) used to shake hoppers, chutes and bins, and consists mainly of an electromagnet and a spring-supported armature. This magnet and armature assembly is the only unit which had to be purchased. All other parts were built or assembled in the laboratories or shops of Princeton University. The credit for suggesting the use of an electromagnetic drive and in particular this commercially available Syntron vibrator is due G. P. Tschebotarioff.

The electromagnet can be fixed above or below the vibrating platform and may excite either vertical or horizontal motions. In case a combination of both is required, two exciter units, one above and one below the platform, become necessary. For horizontal or combined motion an adjustable counterweight has to be installed so that the exciting vibratory forces pass through the center of gravity of the mass system.

Electrical Control

For commercial applications the electromagnet is operated from a 60-cycle power line. In combination with a standard rectifier (**5**) only unidirectional current pulses with a frequency of 60 cycles per sec. excite the magnet. For the vibration table, however, a variable-frequency, electronically controlled source of pulsating current had to be designed in order to obtain other than 60 cycles per sec. The block diagram is shown in Fig. 3. Two-phase power from the 60-cycle mains is converted into direct current by the rectifier. Pulsating unidirectional current of square wave

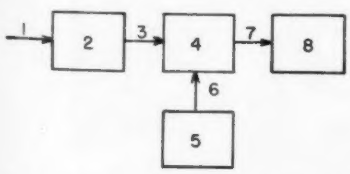

Fig. 3.—Block Diagram of Electrical Control.

1. 60-Cycle power (two-phase)
2. Thyratron rectifier
3. Direct current
4. Controlled thyratron inverter
5. Variable frequency oscillator
6. Control voltage
7. Pulsating unidirectional current
8. Vibrator magnet

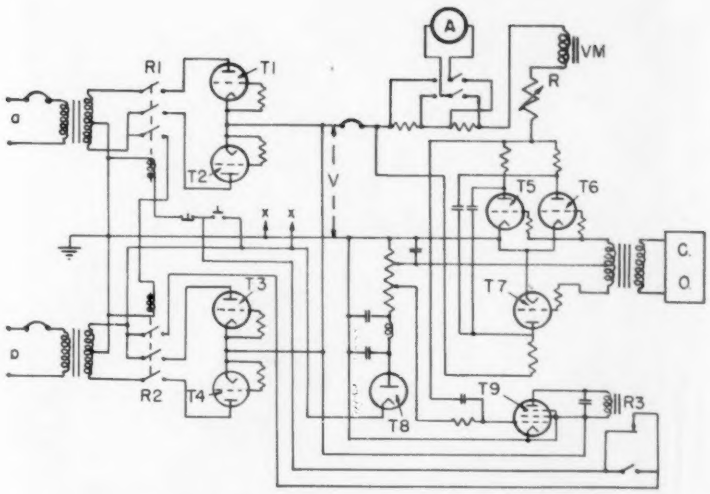

Fig. 4.—Wiring Diagram of Electrical Control.

a and *b* = two-phase power supply
V = Rectified voltage
T1, *T2*, *T3*, *T4* = Rectifier tubes
R1, *R2* = Control relays
T5, *T6*, *T7* = Inverter tubes
VM = Vibrator magnet
CO = Control oscillator
T8 = Rectifier tube for bias voltage
T9 and *R3* = Tube and relay which interrupt current in case pulsation of vibrating current stops
x-x = to all filament transformers
A = ammeter with two ranges (2.5 amp. and 5 amp.)

characteristics is produced through the action of a thyratron inverter, driven by a variable-frequency oscillator (**6**). The frequency of the magnet current may be varied continuously from 7 to 200 cycles per sec. by adjusting the electronic oscillator. The displacement amplitudes are controlled by a rheostat in series with the vibrator magnet, which varies the magnet current, and hence the force acting on the moving masses. The entire equipment with the exception of the electromagnet and table is enclosed in a movable relay-rack cabinet about 6 ft. high (Fig. 2).

Figure 4 shows a diagram of the complete setup. Two-phase power (*a* and *b*) is supplied to rectifier tubes *T1*, *T2*, *T3* and *T4* through isolating transformers and control relays *R1* and *R2*. The purpose of the relays is to interrupt the power upon failure of the voltage of either phase. The rectified voltage *V* is then applied to the thyratron inverter consisting of tubes *T5*, *T6*, and *T7*. Tubes *T5* and *T6* are working in parallel in order to furnish more current to the magnet *VM*, which receives a pulse every time the circuit is fired by the controlling oscillator *CO*. Tube *T8* is a rectifier, supplying a negative voltage (bias) to the grids of the inverter tubes and to the grid of tube *T9*. Relay *R3* and tube *T9* serve to protect the equipment against failure by interrupting the power whenever the pulsation of the vibrator current ceases. The pulsating output maintains the grid of *T9* positive in spite of the negative bias, thus keeping *R3* closed. When *R3* opens, *R1* and *R2* are opened in turn, disconnecting the power input to the rectifier. The circuit *x-x* supplies all filament transformers. For any particular setup, the ammeter *a* in the magnet circuit may be calibrated to read displacement amplitudes of the vibrating platform directly.

Mechanical Control

The purpose of the mechanical control is fourfold—first, to measure

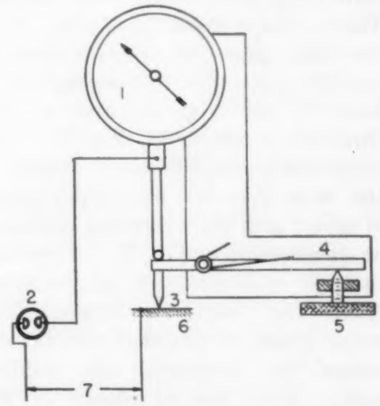

Fig. 5.—Diagram of Mechanical Control.

1. Dial gage
2. Neon lamp
3. Contact point
4. Lever
5. Screw with fine thread
6. Vibrating part (platform or specimen)
7. Line voltage

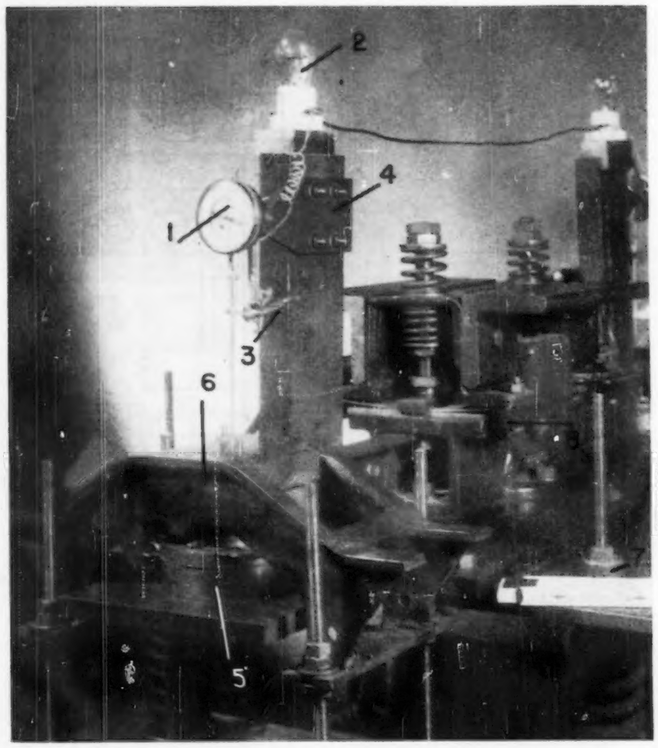

Fig. 6.—Mechanical Controls for Settlement or Consolidation and Amplitudes.

1. Dial gage 0.001 in.
2. Neon lamp
3. Lever with screw for fine adjustment
4. Bolts for rough adjustment
5. Container with soil specimen
6. Frame to suspend loading weights
7. Platform damper
8. Magnet damper

the displacement amplitudes; second, to prevent the needle of the dial gages from vibrating and thus to permit an accurate reading; third, to protect the delicate gear mechanism of the gages from destruction; and fourth, to allow the measurement of settlements (consolidation) in case of soil investigations.

The mechanical control (see Figs. 5 and 6) consists of a dial gage, a neon lamp, and an electrical contact. The movable stem (*3* of Fig. 5) of the dial gage can be lowered or raised gradually by means of a lever (*4* of Fig. 5) and a fine threaded screw (*5* of Fig. 5). An electrical contact is made whenever the stem touches the upper point of reversal of the vibrating platform or specimen (*6* of Fig. 5). This contact is indicated by intermittent flashes of the neon lamp. The lower point of reversal can be obtained by inverting the control unit. Thus the envelopes of the vibratory motion can be measured. An accuracy of 10^{-4} in. has been obtained, that is, approximately the maximum accuracy of the 0.0001-in. dials.

This control was duplicated on two opposite sides of the vibrating platform.

Optical Control

The purpose of this control is twofold; first, to measure the displacement amplitude, and hence to duplicate the mechanical control; and, second, to check the sinusoidal characteristics of the motion.

The optical control (see Figs. 7 and 8) consists of the micrometer-microscope, a graduated glass scale and a stroboscope. The micrometer-microscope (*1* of Fig. 7) is mounted on one of the vertical posts. The cross-hairs in the micrometer can be moved by a drum which is

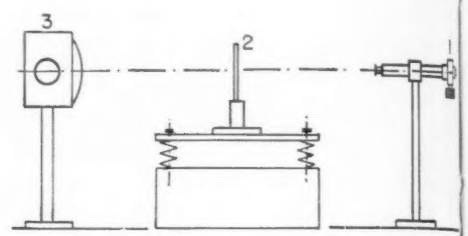

Fig. 7.—Diagram of Optical Control.

1. Micrometer-microscope
2. Glass scale
3. Stroboscope

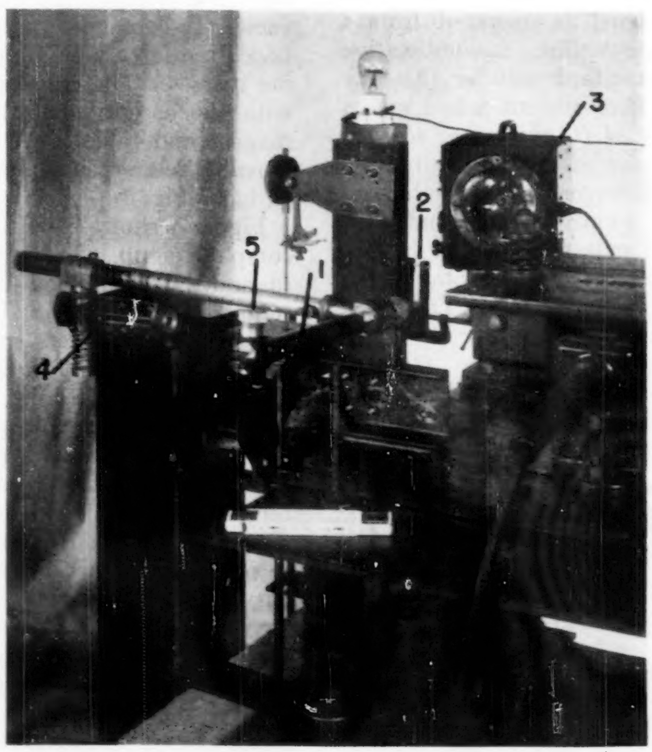

Fig. 8.—Optical Control for Displacement Amplitude and Wave Shape.

1. Micrometer-microscope
2. Transparent glass scale
3. Stroboscope
4. Rough adjustment for micrometer-microscope
5. Fine adjustment for micrometer-microscope

subdivided into 100 intervals. The transparent glass scale (*2* of Fig. 7) is rigidly fixed to the vibrating platform and is graduated in 0.004-in. intervals. One interval of the glass scale corresponds to 600 parts on the micrometer drum. On the drum ± 1.5 intervals could be reproduced. Hence an accuracy of 2×10^{-5} in. was obtained. The stroboscope (*6* of Fig. 7) illuminates the transparent glass scale from a position opposite to the micrometer-microscope. The stroboscope must be adjusted to nearly the same frequency as the vibratory motion so that the lines on the glass scale appear to be moving slowly. Any nonsinusoidal vibration is indicated by irregular changes in this slow motion.

The micrometer-microscope was loaned to the project by the Princeton Materials Testing Laboratory. The stroboscope was loaned by the Princeton Electrical Engineering Department.

Experiments

So far three types of experiments have been made on the vibration table: first, dynamic consolidation tests with soil samples; second, calibration tests of vibrometers; and, third, the recording of hysteresis loops of rubber dampers.

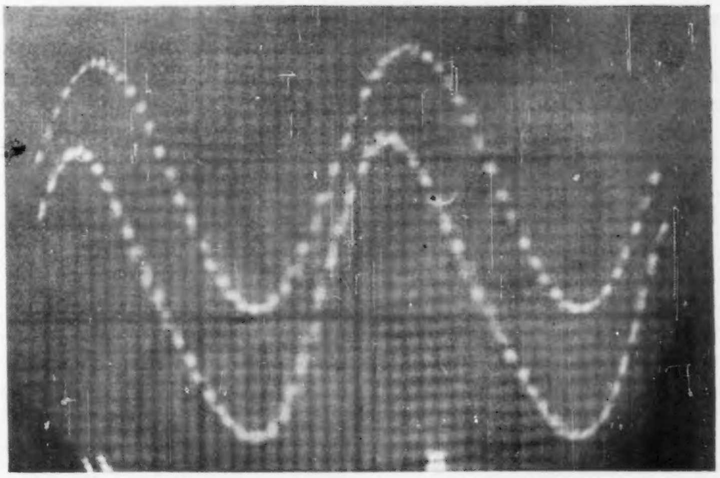

Fig. 10.—Calibration Record of Seismometer on Vibration Table.

Upper curve: Motion of vibration table
Lower curve: Motion as transmitted from seismometer
Frequency: 16 cycles per sec.
Double displacement amplitude: 0.001 in.
Original magnification: × 2000
Exposure time: 1/3.5 sec.
Diaphragm: U S 2

Dynamic Consolidation Tests (**7**):

The purpose of the dynamic consolidation tests (see Figs. 2 and 6) was to obtain load-compression curves of various soils caused by a combination of static and dynamic loads. The dimensions of the cylindrical soil container and the magnitude of the static loads had to be similar to equivalent static tests, in order to facilitate a comparison.

The soil container (*5* of Fig. 6) of a standard type consolidometer is a brass cylinder of 2.5-in. diameter and 1-in. height, supported by the vibrating platform which was cantilevered on two sides. The static loads consist of a series of six weights (*7* of Fig. 2); each successive weight doubles the previous load. The first load weighs 5.625 lb., the final maximum load weighs 360 lb. Any tilting of the soil loading piston could be prevented by lowering the center of gravity of the loading system. By means of a roof-like steel superstructure (*6* of Fig. 6) and the suspension of the additional concrete weights from this structure, the center of gravity could be kept 20 in. below the soil sample surface. Two soil samples are tested simultaneously. However, by cantilevering all four sides of the vibrating platform the number of samples can be increased to four. Ballast was added to the armature of the electromagnet to compensate for the increasing static loads. Thus the weight ratio of the two-mass system could be kept constant. During the tests made so far, the vibrating frequency was 1000 cycles per min., the vertical displacement amplitude was 0.001 in.

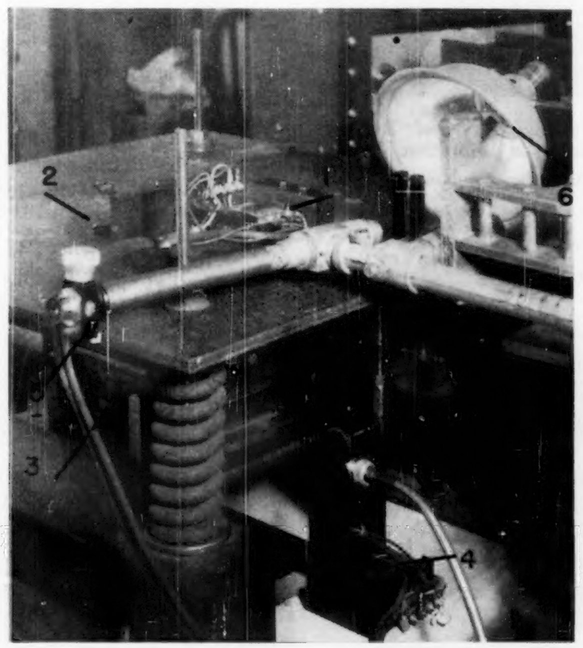

Fig. 9.—Calibration of Seismometer on Vibration Table.

1. Seismometer (pickup unit)
2. Vibration table platform
3. Electromagnet
4. Absolute motion transmitter (pickup unit
5. Micrometer-microscope
6. Stroboscope

Calibration of Instruments:

Newly developed instruments were calibrated by making a comparison between the actual motion of the vibrating platform and the indication of the instrument. Fig-

ure 9 shows the vibration table set up to calibrate a seismometer (*1* of Fig. 9) equipped with SR-4 strain gages (**8**). The electromagnet is fixed below the platform to excite vertical excursions, leaving the top of the table free for mounting instruments to be calibrated. An electronic switch has been used to trace two motions simultaneously, that is, the motion of the table and the record of an instrument. The photograph of a cathode-ray oscillograph record is represented in Fig. 10. The upper curve in Fig. 10 is the actual motion of the table and shows that the exciting current of square wave characteristics can be changed effectively into a pure sinusoidal motion of the vibrating platform. The lower curve represents the record of the seismometer as transmitted by the instrument to be calibrated. The two images must coincide in this particular case. Both sinusoidal curves have the same frequency and amplitude, hence proving that the record of the seismometer is correct, if the slight difference in phase can be neglected.

Determination of Hysteresis Loop:

The area of the hysteresis loop represents the energy dissipation during one complete cycle which can be obtained by plotting the exciting force against the excited deformation. The loop may be used in many cases to determine relative damping and phase angle. A setup similar to that shown in Fig. 9 has been used to record hysteresis loops produced by a standard rubber damper for the support of automobile bodies. The Y-axis of the cathode-ray oscillograph is connected to a pickup unit recording the excursion due to the *elastic* action of the rubber damper; the X-axis is connected to a pickup unit transmitting the excursion due to the *damping* action of the rubber support. Figure 11 shows a photograph of the cathode-ray oscillograph record of one of the resultant hysteresis loops. The phase angle of 14 deg. 20 min. indicates that approximately 25 per cent of the total elastic energy is dissipated by damping action and transformed into heat within the rubber damper.

A more detailed description of this rather unusual application of a vibration table would go beyond the scope of this paper.

Acknowledgments:

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K. H. Condit, Dean of the School of Engineering, and Philip Kissam, Chairman of the Department of

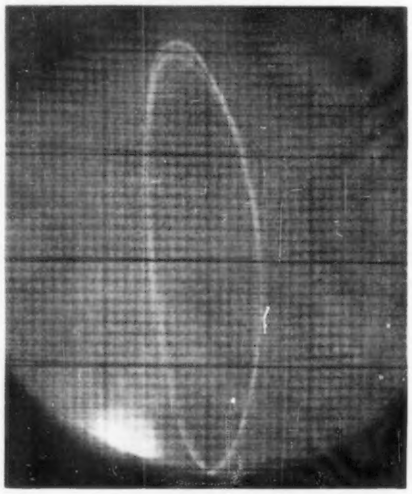

Fig. 11.—Hysteresis Curve of Rubber Damper Produced on Vibration Table.

X-axis: Deformation due to damping action
Original magnification: × 2000
Y-axis: Deformation due to elastic action
Original magnification: × 1000
Phase angle: 14 deg. 20 sec.
Exposure time: 1/3.5 sec.
Diaphragm: U S 2

Civil Engineering, have supported the development of the project at Princeton University.

All investigations on this project are carried out by the Princeton Soil Mechanics Laboratory in the charge of G. P. Tschebotarioff, Director of the Laboratory, whose valuable advice and active participation in all phases of the research have been greatly appreciated.

H. Ashworth, Instructor at the Princeton Aeronautical Engineering Department; C. E. Kjetsaa, Instructor at the Princeton Mechanical Engineering Department; and M. Watson, Technician of the Princeton Electrical Engineering Department, have built and assembled the various units described in this paper.

Members of the Princeton Soil Mechanics Laboratory helped in operating this equipment. E. R. Ward, Research Associate, has contributed considerably to the project, and E. K. Tan, Research Associate, has performed the soil consolidation tests.

The authors of this paper, acting as consultants, have designed the equipment, and have supervised its assembly, its operation, and the experiments.

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Preparation and Use of Specifications

By Gerald Reinsmith[1]

Specifications for any material are written primarily for one of two purposes: either (1) for control of the product offered or (2) for procurement. Material specifications written for the purpose of control offer very little difficulty since a company writes them for its own exclusive use. Therefore, they are free from the usual producer and user battles.

Control Specifications

Control specifications may be divided into two types: those written for sales purpose and those written for manufacturing controls. Sales specifications include physical property values and corresponding test methods which are of interest to material procurers. Manufacturing specifications are either derived from sales specifications or determined by the limits of uniformity guaranteed by the production department. Manufacturing specifications are usually in simplified form and employ rapid test methods to insure reasonable uniformity in day-to-day manufacturing.

Sales specifications or technical sales literature should describe the bad, as well as the good features of a product. In other words, technical information of this type should set forth what the material will not do as well as what the material will do. Showing both the strong and weak points of a product will not harm any honest seller. A perfect material is scarcely expected, but the average advertising prospectus would lead one to believe that each new product placed on the market is the answer to prayers for the perfect product. This situation might be amusing were it not for its serious aspects. Some people believe that advertising and selling will always be done in this manner, but the time will come when less ballyhoo and more facts will be demanded. Competition will tend to bring into line those individuals who exaggerate, since a buyer ordinarily will not go back to a product which once disappointed him.

Procurement Specifications

The procurement or referee specification, which serves as a basis for agreement between producer and consumer, is considered the greatest problem in writing specifications. While the primary use of this type of specification is to convey from the purchaser (or user) to the contractor (or manufacturer) sufficient information as to what is required, there are other uses for this type of specification to which consideration should be given. Some of these uses are:

1. To aid engineers and designers in selecting suitable materials for their products.
2. To promote standardization and simplification.
3. To provide a basis for planning for supply of raw materials.
4. To aid in the conservation and proper use of critical materials.
5. To provide engineering data to serve as an aid in effecting material substitutions.
6. To provide brief but definite instructions to inspectors.
7. To serve as a part of the contract document.
8. To provide information in development work concerning similar products and what will have to be met in order to produce and sell competitively.

Types of Procurement Specifications

There are three generally accepted methods for writing the procurement type of specification. One method is to base the requirements entirely on performance. Another method is to base the requirements entirely on composition. The third, and most widely used, method is to base the requirements on both performance and composition. In most instances, either the composition or type of material is specified and various performance requirements added thereto.

Performance Type:

It is the opinion of many authorities that the ideal specification should be based on performance alone, expressed in recognized physical terms and requirements, using reproducible test methods and standard conditions and with any unusual requirements, words, phrases, or test methods clearly defined. It is recognized that performance may cover a wide field, including factors of physical strength and endurance, corrosion resistance, resistance to flammability, and a number of functional requirements, each of which should be given full and careful consideration in the preparation of the specification.

There are many advantages that can be attributed to performance specifications, one of which is that no manufacturer can claim that his product is being discriminated against. Another important advantage is the ease with which changes from one material to another may be made in times of critical shortages. Materials change in availability while the job to be done remains the same. When composition specifications are used, a considerable amount of time and effort is consumed in changing from one specified composition to another that is available. A performance specification, on the other hand, requires no changes except when changes in availability of materials will prevent compliance with the requirements in question. Another advantage of this type of specification is that the manufacturer is informed as to what is needed and what the material will need to do rather than being told how to make it. In this way, many minds can be attacking the common problem simultaneously, all with the same objective but from

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different viewpoints. This procedure redounds to the benefit of both the consumer and the producer. The manufacturer is permitted to retain his initiative in the development of his own engineering and manufacturing skills and facilities and is free to consider improvement of his product as well as his method of production. The purchaser secures the benefit of all this, and at the same time the purchaser's source of procurement is broadened and his specifications are allowed to remain functional, flexible, and standardized.

An example of this type of thinking may be drawn from a particular line of specification writing. When our crude rubber was lost, technical groups devoted an all-out effort to the preparation of a specification for rubber compounds which would permit an orderly conversion from crude rubber to synthetic rubbers and reclaimed rubbers. In these specifications, A.S.T.M. Tentative Specifications for Rubber and Synthetic Rubber Compounds for Automotive and Aeronautical Applications (D 735 – 43 T)[2] no mention of composition is made. Instead the compounds are grouped in two types and five classes in accordance with oil resistance and physical properties. A code is initiated whereby any compound may be specified with the desired combination of properties. This type of thinking has worked very well in permitting technical development and conversion, since the various types of synthetic rubbers are now being used in combination as well as alone.

An adequate performance specification can be prepared only when all the desirable characteristics of the material are known and are definable, and when accurate short-time tests for these characteristics are known. Unfortunately, however, this situation exists in only a very limited number of instances. If adequate tests to cover the essential properties of a material are known, a specification that is based entirely on performance may tend to become bulky and unwieldly and entail a considerable amount of rather useless testing. Many tests are prolonged and others are rather exacting. It is also recognized that if all the desirable characteristics are not defined, uniformity of the product cannot be expected and unscrupulous manufacturers have a decided advantage over those who are conscientious.

Since it is important to have all requirements pertinent to the application, and any deficiency of the material which may affect the application, thoroughly known and specified, omission of any important requirement or failure to recognize deficiencies of a material which may affect its application for the proposed use, will cause the performance specification to fail to do the job. This fact is the one on which most of the arguments for chemical composition specifications are based, since, in many of the applications, knowledge is not available as to actual requirements needed for the application.

Composition Type:

There are many who consider the composition type of specification preferable to the performance type. In the plastics industry, for example, there is much controversy as to whether specifications should be written on a performance or composition basis. That group which believes that performance requirements are preferable have formed an engineering classification of plastics in which plastics are grouped according to physical and chemical requirements, with a code provided for specifying the desired properties. The group representing the other school of thought insists that the all-important requirement is composition.

It is recognized that all the advantages do not lie with performance specifications. There are those who believe that we shall never have specifications based purely on performance. In support of this belief the case of the informed buyer is cited, that is, one who has complete and accurate knowledge of his performance requirements. Frequently such a buyer has a far more profound knowledge of the correlation between performance and composition than do the producers themselves. Furthermore, in the design of large structures involving public safety, the designer is bound to consider the factor of reliability of a given product based on years of satisfactory service; although he may be able to write a pure performance specification which he thinks would duplicate the product heretofore used in that service, he still may be forced to admit that a change in composition might give rise to unforeseen adverse effects.

A specification based on physical and chemical constants usually gives rise to fewer disputes than one based on some performance test. Nevertheless, there are times when a performance specification is the only way that is known to satisfy the need of the customer. This is true, for example, in the adhesive field. One of the factors in the use of glue is its foaming tendency. There has been a standardized foam test for many years for evaluating the foaming characteristics of glue. However, this "physical value" is not adequate to insure the successful performance of the glue in high-speed paper box construction. It is necessary, therefore, to establish as a manufacturing control a test which is essentially a performance test. This consists of duplicating, in every respect, the coating machine that the box industry uses and testing on this device the product which it is intended to sell to this industry.

Attention is invited, at this time, to one specific type of application where specifications based on chemical characteristics are not only desirable but necessary in lieu of specification based on performance. The application being considered is that in which it is necessary for a material to be in contact with an explosive. It is of paramount importance that the material and the explosive should be compatible, and the most satisfactory method of securing compatibility seems to be designation of the exact chemical composition to be used. This is true because only the ingredients in the specified formulation (rubber, plastics, films, or adhesives) are known to be compatible, and manufacturers are not in a position to perform laboratory tests to determine the explosive's compatibility to alternative compositions. Any substitute used in a formulation may pass immediate physical performance

[2] 1944 Book of A.S.T.M. Standards, Part III, p. 1809.

tests but may prove disastrous when in contact with the explosive over a prolonged period of time and at elevated temperatures. If changes in composition are permitted, the user would need to test each lot shipped, but inclusion of compatibility tests as part of the performance tests upon which acceptance is based is not practicable, since compatibility tests are often of long duration, and decision as to acceptance or rejection would therefore necessarily be delayed. Producers guided by physical performance specifications would find large lots of their material, which passed performance requirements, unacceptable at some later date on the basis of compatibility results. If a shortage of any ingredient used in the specification composition should occur, as might be expected under war conditions, new tests would have to be run regardless of the type of specification (performance or composition) as long as chemical properties were important.

Discriminatory Specifications:

Now it is appropriate to consider the matter of discriminatory specifications a little more fully before passing on. Specifications are not and never will be perfect; neither should they be construed as inviolate or not subject to change and modernization. Every progressive and aggressive producer can generally overcome discriminatory specifications if he really has the "know-how" of manufacturing. On the other hand, the large, well-informed buyer (who generally is the principal one using specifications) can seldom open up his specifications, by the complete omission of requirements of composition and manufacture, so as to prevent at least some partiality. After all, if he has such partiality based on long use and careful study (and many times on extensive testing in which the producers cannot afford to indulge), why should he not be privileged to express his partiality. For instance, if extreme water resistance is wanted in a glue, the question may be raised, why not be thoroughly practical and deliberate in specifying the particular phenolic or other resin types that will give this water resistance, state the performance requirements wanted, and then let the starch or other adhesive manufacturers prove that they can grade their product to meet the specifications? When and as this is done, admit them to the list of approved vendors.

Formulating the Specification

Let us take up in a general way the formulation of an acceptable specification, whether it be based on performance or composition. In writing specifications for procurement, it is important that they be written in such a manner that only one interpretation can be made. Ambiguous statements, too limited information concerning test methods, and the specifying of methods that are not acceptable to industry should be avoided.

Some engineers think that everything which may bear on the specification should be specified. The specification becomes complicated, the user is alarmed, and important requirements are overlooked. Such a situation is usually the result of building a specification around a particular material that has performed satisfactorily and whose entire chemical and physical analysis is included in the specification. There is no doubt that in most every case only a few of the long list of components and physical properties are directly concerned with the use to which the material is being applied. In other words, do not strive for perfection when perfection is not needed. In writing specifications it must be remembered that no one material will give 100 per cent perfection. Specifications must be written to cover materials that will do the job in lieu of the perfect material. It should be remembered that it is just as important not to say what you did not want to say as it is to say what you wanted to say. Complicated specifications have a fortunate tendency to complicating themselves out of existence.

Other specification writers overdo the simplification of specifications, with the result that many important points are overlooked and the specifications need continually to be expanded and clarified by means of letters, cover sheets, work orders, etc.

Another important factor in writing specifications is the use of standard test methods. Methods which are in general use by industry and are generally recognized by organizations such as A.S.T.M. and are acceptable to everyone concerned should be specified. This is highly desirable in order to correlate results between companies, to prevent duplication of work and to allow use of established data. The work of the A.S.T.M. can be of the greatest importance in establishing acceptable standard test methods.

A fallacy in writing specifications is placing too much emphasis on life tests and accelerated laboratory tests, with insistence that the material comply with certain requirements when no known useful purpose is served. It is granted that properly conducted life tests and not too highly accelerated laboratory tests serve useful purposes, as they provide manufacturers, over a period of time an increase in the number of products which can be tested when compared to long-term exposure tests. Further, they assist in eliminating unsuitable materials and afford a more intelligent selection of materials for service testing and contemplated use. It must be remembered that most materials depend upon a number of properties, and, like a chain, are no stronger than the weakest link (or property). Many specifications are not prepared on sound engineering data in that factors such as the right amount or type of cycling are not specified, possible effect of creep, fatigue, or corrosion has not been considered, or the need to specify chemical resistance was not thought of. In many instances a material which would have been cheaper, or would have been substituted in a shortage and have been equally satisfactory, is arbitrarily excluded without sound reasons.

Specific Objectives

In general, a procurement specification should define, as fully and completely as possible, minimum acceptable performance requirements; the *least* that will do the job, not the *most* or the *best*. Specifically, it should set forth:

1. The purpose of the specifications. In A.S.T.M. specifications

this is covered in the Scope. In other specifications, the contemplated use of the material is sometimes included in the Note section.

2. The materials to be used in making test specimens (wood, metal, etc.) or the method of selection of specimens, and the method of preparation for testing.

3. When necessary for reproducibility of test results, the exact conditions under which the tests are to be carried out. Relative humidity, temperature, pressure, quality of reagents, etc., should be specifically defined in terms of sound commercial practices that can be met in the average laboratory. Tests which can be carried out only by purchasing a special type of conditioning cabinet or other device should be avoided. Specifications are recalled requiring ether as a solvent for rubber! This is not only highly inflammable, but so quick-evaporating that it is not practical for making rubber solutions.

4. A statement of the exact method of test to be used for each property for which requirements are specified. The descriptions of the tests preferably should be in a separate document or documents which can be referred to in the material specifications. This helps to clarify the specifications and to keep their length to a minimum. Each method should be described in detailed manner if it has not already been carefully described in some authoritative source to which reference has been made, or is not a generally recognized procedure. Standard time-tested methods should be specified in lieu of radical innovations or more elaborate newer tests, which may be unusually long or tedious even though the former does not always measure a single property perfectly; all details should be accurately defined. Particular care should be taken that only significant tests are required. When making an accelerated aging performance test, new factors may enter the picture, which makes the results of little value. An accelerated aging test under high temperature only, or in a simulated-service type of machine, may give quite different results from those actually obtained in natural weathering and exposure tests. The equipment to be used in conducting tests should be standard, or if not standard, should be specified. For instance, in measuring the shear strength of plywood, widely different values can be obtained by using different types of machines, and in this particular case it might be necessary to prescribe such details as the type of grip, loading rate, and method of sample preparation.

5. Results to be tabulated and the method of computation desired in the report. In writing specifications, a uniform method of preparation and expression of requirements should be followed in order that the full objective of the specification may be realized. The specifications should be boiled down to an absolute minimum. If the specifications exceed a certain length some of the essentials may be overlooked. Before the procurement specifications are written the source of supply should be known and examined in order that what is wanted may be accurately known and material may be prescribed that is typical and can be supplied.

Objectives in General

Procurement specifications should, in general, be definitions of the properties of the material which the purchaser or user desires. They should represent the best efforts to specify, in measurable terms, those properties which are considered necessary for satisfactory use in the contemplated application at the lowest cost consistent with the desired quality. They should also include or specify methods of tests, give information concerning disposition of material in case of failure to comply with requirements, and provide a basis for adequate inspection mutually agreed upon between the contractor and the purchaser.

Performance Type Desirable:

The specification should be based on performance with a suitable breakdown into types, grades, and classes, and with applicable standard original properties (and for certain materials accelerated aged properties) specified for each type, grade, and class so as to provide pertinent properties and comparison under standard conditions. A convenient code arrangement should be provided whereby any group of properties desired may be specified. Materials covered should be readily and economically available, and easily applied in the form most suited for the particular type of service.

An example of this desirable arrangement is the proposed A.S.T.M. specification for gaskets in which all gaskets will be covered in one specification with test methods common thereto included; the gaskets classified according to various types, grades, and classes; and a code provided whereby any gasket can be specified as desired by a number only. Other similar specifications have been prepared for sponge rubber, for rubber compounds, and for plastics, as mentioned.

The Present Situation:

In conclusion it appears that, ideal as the situation would be, specifications for many materials based purely on performance are a long way in the future. Because of the present status of our knowledge, and because any large volume of opposition to preparing purely performance specifications would block rapid development, it is believed that in most specifications the composition or type of material should be specified along with certain performance tests. This is especially applicable to the newer and less well-known materials.

Method of Notching Impact Test Specimens

By S. E. Siemen[1]

One of the chief difficulties involved in the preparation of standard V-notch Charpy impact test specimens lies in the machining of accurately dimensioned notches. It is believed that a tool and technique developed by the author at the Watertown Arsenal Laboratory Machine Shop will not only eliminate the difficulties associated with the machining of the standard 45-deg. angle notch having a radius at the root of 0.010 in., but will enable the production of notches of any desired radius and angle in materials much harder than can be successfully notched by present methods.

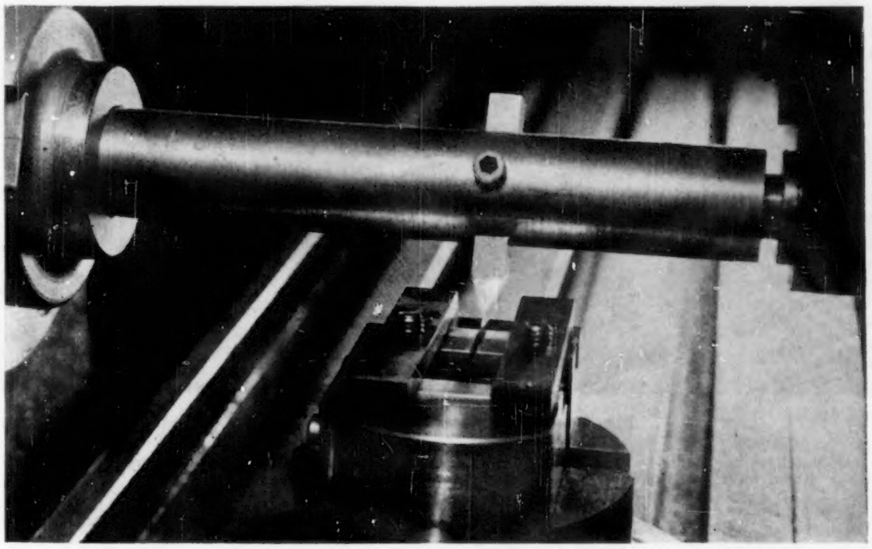


Fig. 2.—Method of Cutting V-Notch Charpy Bars with Carbide-Tipped Cutter in Milling Machine.

The present method of notching V-notch Charpy impact specimens involves the use of a 22-tooth double-angle 45-deg. milling cutter made of high-speed steel. The milling cutter requires careful and time-consuming grinding and its accuracy can only be checked by first machining a notch in a specimen and then measuring the notch. No direct measurement for dimensional accuracy can be made on the milling cutter. The life of the milling cutter is generally quite short, particularly when the steel being notched is somewhat hard. Constant care must be exercised to check the accuracy of the notches being produced.

The tool developed at the Watertown Arsenal consists of a simple 45-deg. angle tool bit with a cemented carbide insert which is ground to the desired notch dimensions. The tool bit is mounted in a spindle which may, if it is desired, be supported at both ends. The tool is set in the spindle so as to have a negative rake, insuring a high order of wear resistance and performance. Figure 1 shows the details of the notching tool and the method in which it is used. Figure 2 is a photograph showing a standard V-notch Charpy impact test specimen being notched by the carbide-tipped cutter.

The dimensional accuracy of notches prepared by the carbide cutter is illustrated in Fig. 3 which shows, at 100 magnifications, notches of 0.002, 0.004, and 0.008-in. radius. These notches were machined in a specimen heat-treated to 477 Brinell hardness. Notches have also been successfully milled in a carburized surface hardened approximately to Rockwell C 60. Conventional milling cutters will not satisfactorily notch steel hardened in excess of approximately 400 Brinell hardness.

The advantages claimed for the carbide tool are:

1. Very large numbers of specimens can be notched between grinds.
2. The dimensions of the notch to be milled in test specimens can be guaranteed by measurement of the dimensions of the cutting edge of the tool.

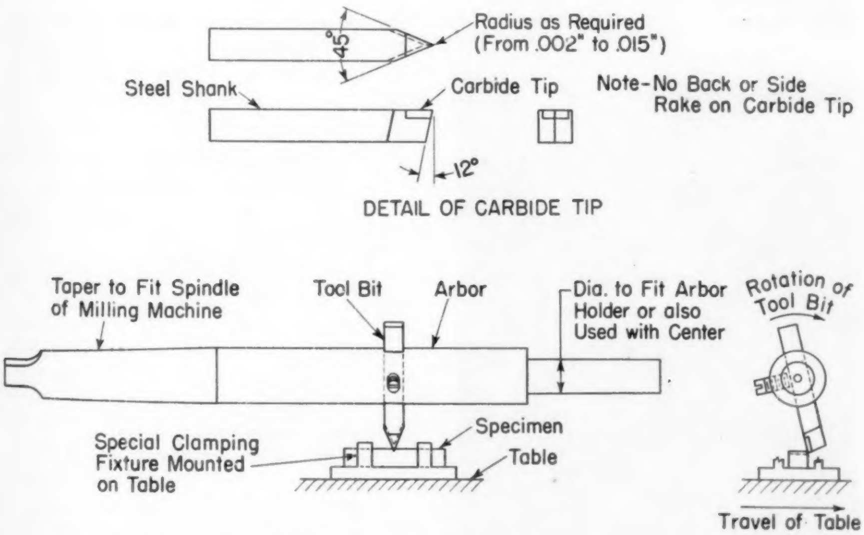


Fig. 1.—Setup for Notching Charpy Bars with Single Carbide Tip Cutter.

NOTE—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia 2, Pa.

[1] Watertown Arsenal Laboratory Machine Shop, Watertown, Mass.

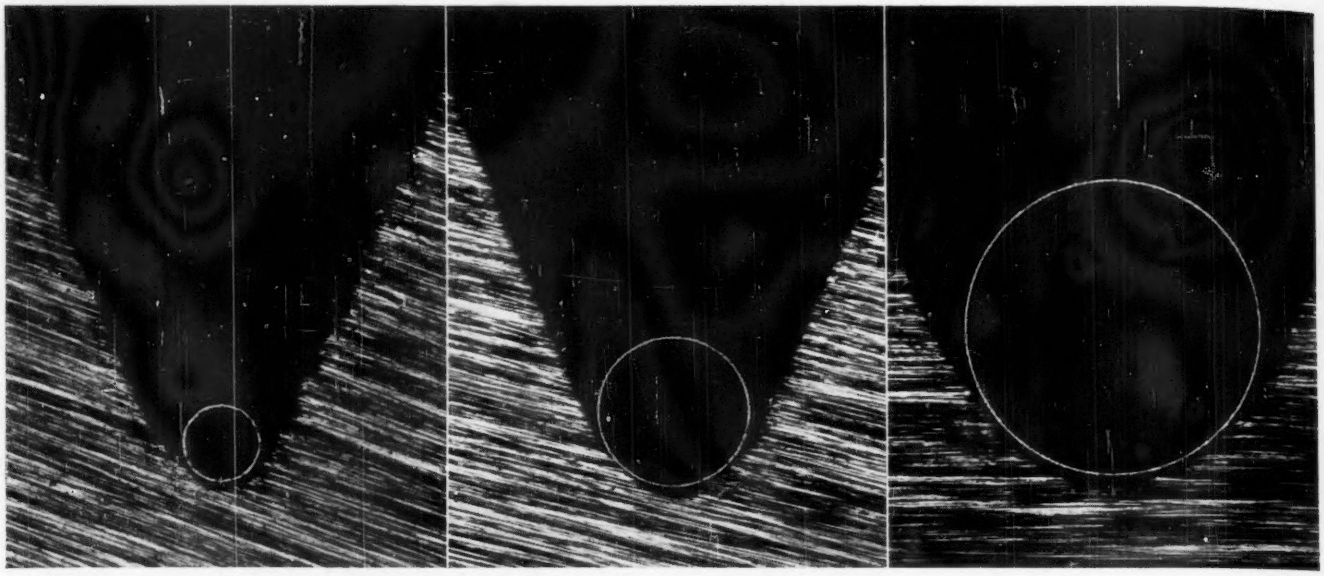


Fig. 3.—Dimensional Accuracy of Notches Prepared by the Carbide Cutter (× 100).

(a) Notch radius 0.002 in. Circle 0.2 in. in radius drawn on photograph.

(b) Notch radius 0.004 in. Circle 0.4 in. in radius drawn on photograph.

(c) Notch radius 0.008 in. Circle 0.8 in. in radius drawn on photograph.

3. Notches of any angle and with notch radii as small as 0.002 in. can be milled in, for example, subsize impact test specimens.

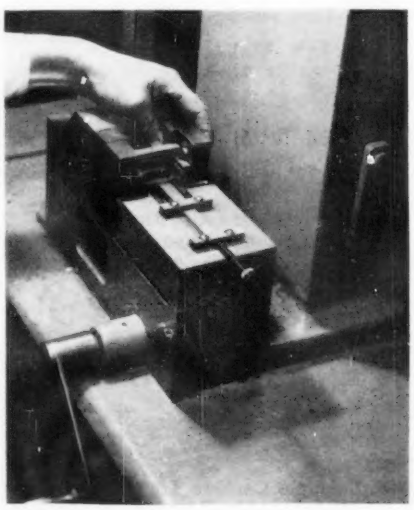
4. Notches can be milled in steels much harder than can be milled by conventional methods.

5. The surface of the notch milled by the carbide cutter is very smooth, approaching a lapped surface. Little cold working and flow of metal is produced.

Improved Guides for Positioning of Impact Specimens

By J. R. Speer[1]

Recent trends in mechanical testing of certain ferrous products seem to be placing increased emphasis on notched-bar impact testing. In addition, a considerable amount of this work involves testing at temperatures either above or below normal room temperature. In view of the increased number of tests and the obvious need for speed in subzero testing, it was found necessary to devise means for minimizing the time lost in positioning the impact specimens in the testing machine. As a step in this direction, two improved guides have been designed for the Tinius Olsen Impact Tester to replace the removable guides normally used for the proper positioning of Izod and Charpy specimens.



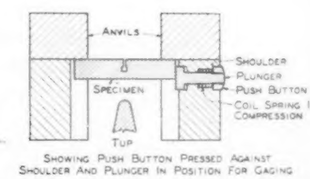


Fig. 1.—A Guide for Centering Charpy Test Specimens.

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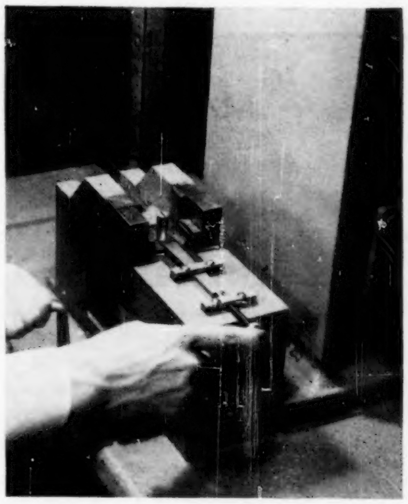
[1] Metallurgist, Research and Development Div., Jones & Laughlin Steel Corp., Pittsburgh, Pa.

The device illustrated in Fig. 1 is used for Charpy testing and consists of a push button set into the side of the specimen supports of the impact tester. It is designed to act as a stop for positioning the specimen so that the notch is always centered between the anvils. On release of the button, the guide automatically springs back and does not interfere with the test. This guide has proved invaluable for low-temperature impact testing where it is necessary to break the specimens as soon as possible after drawing from the coolant.

The other device, illustrated in Fig. 2, is used for Izod testing and consists of a sliding guide which is pushed into the notch of the Izod specimen to hold it in its correct location for testing. After the specimen is clamped in the vise, the guide springs back out of the way.

The removable guides ordinarily used to position impact specimens are cumbersome and, in some respects, interfere with testing since they must be laid aside prior to releasing the hammer and then retrieved and replaced for the next test. In addition, there is always the possibility that the guide may not be removed before releasing the hammer; this would result in an invalid test and perhaps damage the guide and parts of the tester.



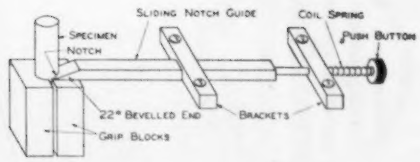


Fig. 2.—A Guide for Positioning Izod Test Specimens.

With proper modification, these devices can probably be easily installed on any impact tester by a competent machinist.

Ball and Roller Bearing Engineering

PUBLISHED by SKF Industries, Inc., Philadelphia, is an English translation of Dr. Arvid Palmgren's book on "Ball and Roller Bearing Engineering." The book is intended to provide a general knowledge of the bearing elements and also to give machine designers significant data on bearing engineering as used in their fields. There are numerous bibliographic references and extensive tables and a large number of figures, mostly line drawings. Extensive tables of tolerances, conversion values, etc., are helpful and there is a detailed index. 270 pages, cloth binding, page size 7 by 9¾ in.

British Book on Analysis by the Spectrograph

FOR SOME years the British Non-Ferrous Metals Research Association's Subcommittee on Metallurgical Applications of the Spectrograph has operated through various panels covering different aspects of the work. Apart from guiding the Association's own researches the members have also provided results obtained in their own laboratories. In this way a considerable number of reports have been distributed.

This present volume contains a selection of thirteen papers based on these various reports: two on the processing and calibration of the photographic plate; four on analysis of aluminum and aluminum alloys; three on lead and lead alloys; one on zinc alloys; two on copper alloys (aluminum bronze and beryllium copper alloys); and one on platinum.

The book is not a systematic treatise on the spectrographic analysis of metals and alloys, but many of the papers make practical recommendations on various aspects of technique. The papers cover a wide range and the publication should be of interest to all engaged in the spectrographic analysis of non-ferrous metals.

This 172-page book, cloth binding, 58 figs., page size 6 by 9¾ in., can be obtained from the B.N.F.R.A., Euston St., London, N. W. 1, at 21 shillings.

Theory of Structures

IN THE field of theoretical and applied mechanics, any book bearing the name of Professor S. Timoshenko of Stanford University immediately commands attention. There has just been published by McGraw-Hill Book Co. a new volume on the Theory of Structures by Professor Timoshenko and D. H. Young, Associate Professor of Civil Engineering of Stanford. This book is intended primarily for engineering students and in its preparation the authors have tried to keep in mind the fact that theory of structures is based on mechanics with which the student is already familiar. Thus by establishing a close relationship between the teaching of mechanics and structures, the book helps the student to understand the various practical methods of analysis of trusses and frames. With this point of view, the first chapter offers an introduction to the theory of structures in which the basic principles of statics are recapitulated. Succeeding chapters deal with the analysis of statically determinate trusses in one plane, influence lines, formation and analysis of space trusses with hinged joints, principles of mechanics preparatory to the analysis of statically indeterminate structures, methods of calculating deflections of trusses, theory of statically indeterminate trusses, bending of beams and frames, and the theory of arches.

To add to its usefulness the authors have added an index which makes the textbook of particular use to all engineers as well as students. The book can be obtained in cloth binding, page size 6 by 9 in., 485 pages, at $5 per copy.

ASTM Bulletin

MARCH 1946

NO. 139

TWO-SIXTY
SOUTH BROAD ST.
PHILADELPHIA 2, PENNA.

Society Receives Navy Award

THE United States Navy's Certificate of Achievement has been awarded to the Society in recognition of exceptional accomplishment in behalf of the United States Navy and of meritorious contribution to the national war effort. The Navy has indicated that this Certificate "signalizes the Navy's recognition of the splendid effort put forth by the men and women of your organization in support of the war production program." Members will recall that the Society received over a year ago the Army Ordnance Department's Distinguished Service Award and recently several of the A.S.T.M. technical committees have received letters of commendation from various branches of the service for special work in connection with the war effort. This group of committees includes Committee D-20 on Plastics, Committee D-12 on Soaps and Detergents, and the Rubber Committee's Technical Committee A on Automotive Rubber.

The Navy Department is represented on a large number of technical committees and has several memberships in the Society including four held in perpetuity which were established in 1911. Two of these are held in the name of the Bureau of Ships, one the Bureau of Aeronautics, and one the Bureau of Ordnance. A great deal of the Society's work is of direct interest to the Navy and there is constantly an exchange of information which is mutually beneficial.

The Society is very pleased to receive the recognition through this Certificate of Achievement, which has been suitably acknowledged by the Executive Committee.

Nominations for Officers

THE NOMINATING Committee to select nominees for Society officers met in Philadelphia on March 5. The personnel of this group was listed in the January BULLETIN. In accordance with the provisions of the By-laws of the Society the following nominations are announced:

For President (term 1 year):
Arthur W. Carpenter, Manager of Testing Laboratories, The B. F. Goodrich Co., Akron, Ohio.

For Vice-President (term 2 years):
R. L. Templin, Assistant Director of Research and Chief Engineer of Tests, Aluminum Co. of America, New Kensington, Pa.

For Board of Directors (term 3 years):
A. G. Ashcroft, Director of Research, Alexander Smith and Sons Carpet Co., Yonkers, N. Y.
A. T. Chameroy, Manager of Merchandise Testing and Development Laboratory, Sears, Roebuck and Co., Chicago, Ill.
J. H. Foote, Supervising Engineer, The Commonwealth & Southern Corp., Jackson, Mich.
F. E. Richart, Research Professor of Engineering Materials, University of Illinois, Urbana, Ill.
L. H. Winkler, Metallurgical Engineer, Bethlehem Steel Co., Inc., Bethlehem, Pa.

Each of the above nominees has indicated in writing his acceptance of his nomination. The By-laws provide that "further nominations, signed by at least 25 members, may be submitted to the Executive Secretary in writing by May 25, and a nomination so made, if accepted by the member nominated, shall be placed on the official ballot" which "shall be issued to members between May 25 and June 1."

In line with the revised By-laws the new arrangement with respect to officers will become effective at the close of the 1946 Annual Meeting since the appropriate Court in the State of Pennsylvania has authorized the amendment of the Charter which will permit a Board of Directors instead of the present Executive Committee. This Board of Directors is to comprise fifteen members in addition to the President, Vice-Presidents and last three Past-Presidents. The Directors are to have a 3-year term instead of the present 2-year term for the Executive Committee. For the period 1946–47 the Directors would consist of the present ten members of the Executive Committee whose terms will automatically be extended, and if elected, the five new members who are being nominated.

There will be no change in the length of the term of office for the President or the Vice-Presidents, so that each year there will be nominated candidates for President (term 1 year), for Vice-President (term 2 years), and five Directors (term 3 years).

New Headquarters to Be Occupied on May 1; New Address Will Be 1916 Race St., Phila. 3, Pa.

SUFFICIENT progress is being made on the permanent headquarters building to permit the headquarters Staff to move on or about May 1. It is not expected that all of the alterations will have been completed—in fact there is still much to be done in the front or public portion of the building—but the various offices and facilities will be at a point where there should be no great handicaps in occupying the building. The officers are desirous that the Staff get moved and acclimated as soon as possible. This will release the present headquarters space which the owners of the building are most anxious to have available. They have been

most cooperative in granting an extension of the lease which expired the end of last year.

It is planned in one of the future BULLETINS to give a rather detailed story with illustrations and floor plans of the building. The address after May 1 will be 1916 Race St., Philadelphia 3, Pa.

BUILDING FUND

Since the January BULLETIN, additional contributions have been received to the A.S.T.M. Building Fund as follows:

COMPANIES:

American Cyanamid Corp.
Ford Motor Co.
Metal Lath Manufacturers Assn.
Otis Elevator Co.
Pennsylvania Salt Manufacturing Co.
Taylor Instrument Co.

INDIVIDUALS:

Bigelow, M. H.   Hyams, H.
Cady, W. H.   Schlick, W. J.
Scofield, H. H.

Including these, the total contributed is now very close to $150,000.

Members' Aid Asked in Connection with Membership

AS A result of a communication and return form sent to each member of the Society, the Committee on Membership, which functions as a subgroup of the Executive Committee, has received many suggestions of both companies and individuals who would benefit from affiliation with the Society, and invitations are being extended. It is somewhat surprising to find how many of the organizations and individuals are well known and yet apparently have not been members of A.S.T.M., although the activities in general should have been of more than passing interest. Of course, a great many organizations make effective use of the Society's publications and particularly the specifications and test methods, procuring the information through purchase of the various books and pamphlets. In this connection membership does carry one great asset, namely, the surety that the regular publications will reach companies and individuals regularly on their membership.

The Membership Committee is very anxious to acquaint those who are interested in engineering materials with the advantages of membership, and is prepared to send information to any individuals whom the members may suggest.

Sustaining Membership:

We are pleased to announce the acquisition of a Sustaining Membership by the Ohio Steel Foundry Co., at Lima, Ohio, which membership will continue to be represented by H. R. McCoy, Chief Metallurgist. This company has been affiliated with the Society since 1921.

New ASA Executive Committee

A NEW Executive Committee has been organized by the American Standards Association which will have to do with the financial, administrative and executive direction of the association. This committee is headed by Mr. Howard Coonley, formerly president and board chairman of the Walworth Company and a past president of ASA. Active in World War I as vice-president of the Emergency Fleet Corporation, he also served in the Second World War as head for many months of the WPB Conservation Division, and later he was adviser to the Chinese Government in connection with their War Production Board. Mr. Coonley is expected to give virtually full time to the direction of the ASA program which will involve a number of responsibilities indicated in the so-called Wilson Committee report to the Secretary of Commerce.

Serving with Mr. Coonley on the Executive Committee are the following:

Henry B. Bryans, President ASA and Executive Vice-President Philadelphia Electric Co.
Frederick R. Lack, Vice-President ASA and Vice-President Western Electric Co.
Clarence L. Collens, Chairman of the Board, Reliance Electric and Engineering Company
George H. Taber, Jr., President, Sinclair Refining Co.

New Committee on Methods of Testing Building Constructions

THE organization meeting of the new Technical Committee on Methods of Testing Building Constructions (Committee E-6) was held at the National Bureau of Standards in Washington on January 23. This is the first committee to be organized under the sponsorship of the Administrative Committee on Simulated Service Testing and represents something of a departure from A.S.T.M. activities in that it extends committee work to include the testing of parts and structures.

The formation of such a committee was on the recommendation of a special committee under the chairmanship of D. E. Parsons. This special committee, composed of men who are familiar with the problem, discussed it at some length and recommended to the Administrative Committee a scope for the new committee and the initial personnel. The scope as finally approved by the A.S.T.M. Executive Committee is as follows:

> To formulate methods of test for building constructions, including elements, connections and assemblies, under actual or simulated service conditions, applicable to the evaluation of such factors as materials, design, construction and fabrication.

The initial personnel, as the committee commences its work in this important field is as follows:

Ashby, Wallace J.	Div. of Farm Structures, Dept. of Agriculture
Boester, Carl F.	Purdue University
Boase, A. J.	Portland Cemen Assn.
Carlson, Roy W.	University of California
Coe, Theodore I.	American Institute of Architects
Courtney, J. H.	National Bureau of Standards (rep. American Standards Assn.)

Ellis, A. R.	Pittsburgh Testing Lab.
Frankland, J. M.	Chance Vought Aircraft Div. of United Aircraft Corp.
Guion, W. D.	The Building Officials Conference of America, Inc.
Hanrahan, F. J.	National Lumber Mfrs. Assn.
Hartmann, E. C.	Aluminum Company of America
Hein, Peter	Public Buildings Administration
Higgins, T. R.	American Institute of Steel Construction
Korsmo, A. M.	Federal Public Housing Authority
Markwardt, L. J.	U. S. Forest Products Lab.
Parsons, Douglas E.	National Bureau of Standards
Perkins, N. S.	Douglas Fir Plywood Assn.
Plummer, Harry C.	Structural Clay Products Inst.
Rapp, George M.	The John B. Pierce Foundation
Richart, Frank E.	University of Illinois
Robinson, Hugh	Underwriters' Lab., Inc.
Rogers, Tyler S.	Owens - Corning Fiberglas Corp.
Schweim, H. J.	Gypsum Assn.
Stacy, H. A.	U. S. N., Bureau of Yards and Docks
Voss, Walter C.	Massachusetts Institute of Technology
Whittemore, H. L.	National Bureau of Standards
Wood, B. L.	American Iron and Steel Inst.
Wendt, K. F.	University of Wisconsin.

The meeting was called by L. J. Markwardt, the temporary Chairman. He was elected by the meeting to be permanent Chairman and Professor F. E. Richart was elected Vice-Chairman and J. H. Courtney, Secretary. The committee selected a few topics on which work should be initiated, including the testing of panels, trusses, and arches. The following subcommittees were set up to deal with these suggestions:

Subcommittee 1—Panels for Light-Building Construction
Subcommittee 2—Connections and Assembled Structures
Subcommittee 3—Large Structural Units (Trusses, Girders, Arches)
Subcommittee 4—General Structural Elements

It is planned to carry on the activities in such a way as to give primary emphasis at the start to work that will be of immediate assistance in the construction of low-cost housing.

Northern California District Has Interesting Meeting in San Francisco

On January 29, the A.S.T.M. Northern California District held its first postwar dinner meeting at the Engineer's Club of San Francisco. Almost 100 members of various local engineering groups and guests were present to hear an address by Mr. E. S. Lee, Engineer-in-Charge of General Electric Company's General Engineering and Consulting Laboratory, Schenectady, on the subject "What Is New in Science and Engineering."

Presiding at the meeting was Dozier Finley, Chairman of our Northern California District Committee and occupying a place of honor at the speaker's table was E. O. Slater, Chairman of the Southern California District Committee. In spite of the traditional rivalry between the cities of San Francisco and Los Angeles, the friendly spirit that exists between the Northern and Southern California A.S.T.M. groups is exemplified by the accompanying photograph of Chairman Finley introducing Chairman Slater to the gathering.

At the speakers' table, seated from left to right facing camera, were R. O. Brosemer, F. M. Harris, T. P. Dresser, M. C. Poulsen, P. V. Garin (all members of the Northern California Committee) E. S. Lee (the speaker), Chairman Finley, and Chairman Slater.

Mr. Lee's talk, which is outlined in the attached newspaper article prepared by General Electric Co., was very timely in that it brought before the audience by means of slides some of the latest developments in the field of measurements and measurement control. Mr. Lee has been closely associated with this work and is an authority on the subject. Mr. Lee praised the work of the A.S.T.M. in the standardization field and emphasized how important such standardization is to industry as a whole. He pointed out that when laboratories and technical men work to standard procedures, a common basis is provided on which progress can readily be made.

Representatives of local branches of A.S.M.E., A.I.E.E., A.S.C.E., A.W.S., A.I.M.E., A.C.S., S.A.E., A.S.M., and Structural Engineers of California were present at the meeting.

Everett S. Lee

Abstract of Address of E. S. Lee

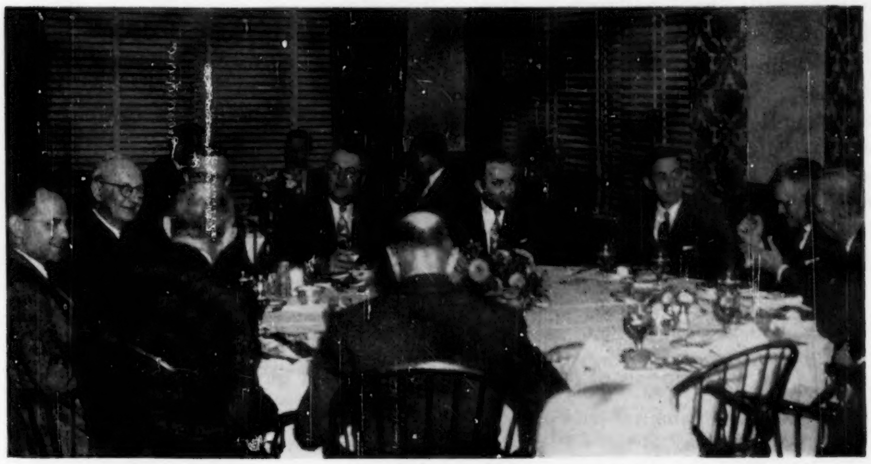
Measurements Behind All New Developments; Electronic Tubes Gage Color; Very Small Quantities; Sound and Surface Conditions

Discussing new developments in science and engineering, Mr. Lee declared that "measurements were fundamental and that for every new development there was a measurement story present." He told the group that the new measuring instruments being constantly developed for studying the new materials and processes and machinery and appliances were most wonderful in themselves because of what they accomplish.

"Many of these have come from the war production where progress was great," he said, "and many of the outstanding accomplishments during the war go back to accomplishments many years previous in which a "know-how" was developed."

New instruments developed to control

Northern California District-Chairman Finley introducing Southern California District-Chairman Slater (right).



Speakers' Table, l. to r. (facing camera), R. O. Brosemer, F. M. Harris, T. P. Dresser, M. C. Poulsen, P. V. Garin, E. S. Lee, Chairman Finley and Chairman Slater.

the processes for the manufacture of materials for the atomic bomb, he said, go back to the late Dr. Charles P. Steinmetz, G. E.'s "mathematical wizard," and the work done by his associate engineers in measuring lightning on power transmission lines. The power lines were made safe from lightning to give light and power service without interruptions, and the resulting engineering and measuring technique ability were ready for the atomic developments which later were such a power in winning the war.

Radar

Radar, which also contributed so outstandingly to Allied victory, is itself a measurement. One of its first peacetime applications is aboard ships where it locates objects through fog and darkness and measures the distance to the objects which the ship must escape, and there will be extension of this principle to other transportation as time advances.

Application of electronic tubes to measurements continues to increase daily. He explained that color is measured with the recording spectrophotometer, sound is measured with the sound-level meter, and the measurement of very small quantities is carried out with the photoelectric recorder.

Yarn Diameter Gage

Among the newer instruments using the electronic tubes are the yarn diameter recorder and controls for the diameter of yarn—a most ingenious application; the mercury vapor detector for instantly measuring the amount of mercury vapor in air for control of atmosphere; gas analysis equipment of many varieties, including the mass spectrometer; new cathode-ray oscillographs for circuits measurements, and the winding insulation tester emanating therefrom for testing the insulation of motor and generator windings.

The electron diffraction instrument for studying the surface condition of materials is becoming more and more popular, he pointed out, and magnetic comparators for quality control of magnetic materials are in good use and study for the application to nonmagnetic metallic materials is in progress.

Constantly Improving

"Industry constantly is improving its manufacturing methods to give an ever-increasing output of quality products so that the American consumer may have the best," Mr. Lee said. "The examples of this mount into thousands and thousands unbeknown to the public who are the recipients of the quality products industry provides."

Referring to the Virginian Railway Company's recently announced 8000-horsepower electric locomotive—the largest ever built, Lee declared that "In the knowledge of the design of such a locomotive there are the diminutive measuring electromagnetic strain gages that give a knowledge of the strain and stress in these enormous machines."

An Integral Part

He added that the measuring instruments not only serve for the materials and in the designs, but they also are an integral part of the equipment, to assure performance which is again the best that engineers can design and industry can produce.

"Lord Kelvin, noted British physicist, has said that when you can measure what you are speaking about, you know something about it," Lee said, concluding:

"That is a great truth and it attests to the great advances that have been made by the industry where knowledge is power. And to the scientist and the engineer who use these measurements and to the measurements engineer who produces them, great credit is due."

Meetings in Philadelphia and Buffalo on Housing and Housing Materials

The Philadelphia and the Western New York-Ontario Districts were privileged to present at meetings sponsored in Philadelphia and Buffalo, on Feb. 14 and March 7 respectively, Professor Walter C. Voss, Head, Department of Building Engineering and Construction, Massachusetts Institute of Technology, Cambridge, Mass., who spoke at each meeting, with James W. Kideney, prominent Buffalo architect, speaking at the meeting there, and in Philadelphia, John T. Grisdale, partner in the firm of Carroll and Grisdale. These men covered the various aspects of materials, development planning, and really gave those at the meeting an excellent concept of some of the problems and ramifications involved.

Professor Voss has made intensive studies of this whole field, and a summary or consensus of his presentation appears below.

Mr. Kideney spoke from extensive notes which are also summarized here.

In Philadelphia, Judson F. Vogdes, Director, Philadelphia Committee, Pennsylvania Economy

League, and Vice-Chairman of the District, had arranged the program which included discussion by local men intimately concerned with housing—Harrold Hoffman, Secretary of the General Contractors Association, and Arnold Doehler, President of the Producers Council. Mr. Hoffman who spoke briefly but very much to the point stressed the importance of constructing new houses for those who most need them and called attention to the fact that much of the demand is coming from people now reasonably comfortably housed and who it seems might logically control their desires a bit longer.

In Buffalo, District Chairman B. L. McCarthy, Colorado Fuel and Iron Corp., planned the meeting with the close cooperation of Secretary T. L. Mayer, who presided at the meeting. In the case of both meetings informal dinners preceded the technical sessions. There was good attendance at each of the meetings.

A Synopsis of Mr. Kideney's Discussion on Housing

Mr. Kideney paid tribute to A.S.T.M., referring to the widespread use by architects of the large number of A.S.T.M. specifications and tests covering building materials. He pointed out that for numerous reasons architects could not hope to be competent on all of the materials, but relied greatly on the Society's authoritative documents. He cited, for example, the use he was making of the specifications for ready-mixed concrete. He expressed a hope that the work be continued intensively and felt that the architects generally were quite willing to cooperate.

Housing can be classified under five broad headings: (1) Public; (2) Private; (3) Individual; (4) Developments sponsored by large financial institutions; and (5) Redevelopment. Public housing has perhaps been publicized out of proportion to the percentage of the total. Private housing, probably the most important, is frequently financed with Federal or state assistance.

Public housing has three major defects. It doesn't seem to reach the lowest level, and being set up with a maximum income classification, people who improve their financial position may be evicted, and frequently it has not been generally integrated into the neighborhood with little attempt to meet local conditions.

Private housing, frequently built with Federal assistance, includes a large range of low and moderate cost developments. This requires good site planning with play areas, reasonably sized lots, etc., and needs to be coordinated with public schools, and other neighborhood facilities. There may be complete lack of control by the local planning agency in a community, even where one exists. It was pointed out that the Federal Housing Authority has definitely improved the standards of the individual house, and where there was the opportunity, subdivision layouts also have been improved. Mr. Kideney stressed the fact that if developments could really be consolidated, so that an entire neighborhood could be substantially completed before new developments start, housing in America would really begin to "look up."

On another phase—some of the large financial institutions can be expected to continue their large interest in real estate development. In some of these there may not be sufficient disposition for incorporation of the non-income bearing improvements.

Redevelopment, which might be called slum clearance projects, will probably continue to be the largest single problem of a city. It is particularly difficult to work out a sound fiscal basis. In New York in 1940 a law was enacted which was intended to facilitate the assemblage of properties into one ownership, and tax planning is possible.

Individual Homes—With larger projects in process, there seems to be little planning involving the individual home. The newer model will probably be the same as the 1941 or 1942 model, with the usual improvements—something like the automobile. What is needed is a good plan, whether it is Cape Cod, Gold Fish Bowl, or just good architecture which requires good construction and intelligent choice of materials. He expects no revolutionary changes. He pointed out that radiant heat is not new, that the Romans used it in their baths, and that about 50 years ago it was taken up again in England.

Prefabrication—Mr. Kideney stated that we may be surprised at the progress, particularly if some large organization can get going with prefabrication, which is essentially to reduce cost. It may not really be cheaper, but certainly is faster.

He concluded with a critical discussion of the Wagner-Ellender-Taft bill which is being considered by Congress, feeling that many of the provisions are illogical.

Résumé of Professor Voss' Discussion on Housing

Based on very extensive experience and intensive study, Professor Voss feels that the best hope for real production in housing must involve a prefabricated system, but a use of modular structural units which embody great flexibility. He said, "If the module is chosen wisely and as small as can be used economically, design, arrangement, size and cost can be varied to the greatest extent. If, in addition, these parts are assembled in such a way that they can be dismantled easily without disturbing the rest of the structure to any great extent, then the owner may grow with his economic conditions and he may modernize his home at small cost from time to time. He can have reasonable control of exterior and interior finishes and he may get his house just as cheaply if he builds on a single lot as if he bought in a new development. At least he has the choice."

Income Groups:

The speaker made clear that his discussions involved primarily the middle income group which might be the $2000 to $5000 annual income classification. About 20 per cent of the families have incomes over $5000 and are able to pay the necessary cost of site fabrication and erection, even though it may be wasteful. Considering the lower income group—about 47 per cent, with less than $2000 income—he felt present developments made it doubtful that we are going to be able to reach this group, for some time at least. He felt it desirable to concentrate his talk on the middle group which on the acknowledged basis of investing not more than 2 to 2½ times the annual income in a house, would mean a housing cost of from $4000 to $12,500.

He stressed that housing and home ownership is at the very core of our American way of life, and that the more people who own their homes on a sound fiscal basis, the better cushion we will have against "isms" of all kinds.

Concerning Materials and Services:

While some materials and services may develop much more rapidly than anticipated, from the angle of the housing group he was considering, a widespread use of plastics and light metals seems

W. C. Voss

John T. Grisdale

J. W. Kideney

doubtful—at least for the immediate future. For minor decorations, etc., there may be increasing use. Air conditioning is not yet integrated with construction and insulation, and considering insulation, we need to continue intensive study, particularly the effect of dew point on the structure. Vapor barriers should be required. Likewise with radiant heat, it is still in the high cost range and its relationship to other materials must be carefully evaluated. Solar heat is still in the experimental stage, but absorbing panels are now available with glass side walls, the most favored setup. For a while, the cost will continue to be high.

Architectural Approaches:

Professor Voss discussed various types of architectural developments, including the concrete monolith, the structural skeleton, the dymaxion house, etc. The concrete monolith may be expensive and require a great deal of integrated study. The igloo or bubble type house would involve a definite design and perhaps be monotonously repetitive, and would involve real problems with interior compartment-izing. Dymaxion houses, according to Professor Voss, would use the central mast principle, and would involve more or less regular circular, or polygonal design. Current building codes may have a very retarding effect on some of these developments.

Methods of Construction:

If conventional methods are used, the result will be of variable quality and involve frozen equities and no logical mechanical method of change. Site fabrication is likely to create monotonous sameness and involve high field split-time costs of labor. It may have tremendous tax impacts on the community. The package house involves the concentration of house production in certain areas in the country, regimented design and expensive transport of finished products. This is a step in the proper direction but does not possess all of the characteristics which should be present in prefabricated housing. Full wall, floor and roof panels and full room units involve restricted design, limit the architectural arrangement, force the acceptance of architectural effects, but have the advantage of local construction.

Modular structural panels, Professor Voss stated, are the only reasonable approach which gives all the freedoms noted below, providing the module is selected so as to give a wide variety of size. This can be done and experimentation proves that it will give considerable freedom in mass production. Cost would be in the range from $4000 to $5000.

Freedoms:

The owner should have freedom of choice, of style, arrangement, and location. He should be allowed any style of design which he wishes to have and an arrangement which best suits him and which can be readily changed even after the house is built, and it should be possible to build a house on a single lot which the owner holds just as cheaply as building many of them in one location. The owner's equity must be protected by means of easy remodelling, easy repairs and by providing ready liquidation. The mortgagor's equity must be protected by methods of life insurance and a reserve fund which can be used to reduce the rate of interest and still protect the mortgagor's investment. It also protects the owner as a drawing account in case of sickness, death, or unemployment.

Obstructions:

With land values still one of the major obstructions to relatively low costs, there seem to be no good reasons why land should be considered so valuable. He cited cases where at one time land could be picked up reasonably, and with the construction of one or two dwellings, terrific increases were the result. Finances are moving in the direction of lower cost, but building and zoning codes are quite obsolete in connection with low-cost construction, and do not cover adequately new structure methods and framing.

The author stressed the fact that although labor union policy will have a great effect on housing cost, if annual wages were assured with continuous employment, perhaps unions could justifiably drop a contention that hourly rates must be high because of split-time employment. Labor must cooperate in the housing effort, not only for public benefit, but for themselves. Labor can also help by increasing production of its craftsmen to justify increasing wages, and also there must be greater flexibility in the type of work any man can do in a plant if he is able.

Financing:

Professor Voss discussed this angle at some length because it is a basic one in the problem. Providing that those concerned with the production of materials and housing design and construction can develop a series of suitable houses in the $4000 to $12,500 class, then probably financing should enable the middle ⅓ group to handle the commitments without undue burden. In the case of a married couple, with the husband 25 years old, whose income is approximately $2000 per year, he would be justified in spending in the neighborhood of $5000 (such a home might include a living-dining room, kitchen, bath room and one bedroom, and would include land which would cost not more than $500). An interesting table has been worked out to show that an investment of $4500, plus $500 down payment, amortized over a period of from 15 to 30 years could be handled at a quite low monthly cost, providing the bank or other agency holding the mortage will keep the

$4500 MORTGAGE—ASSESSED VALUATION $4000

	Interest, Amortization Taxes and Fire Insurance		Interest, Amortization Taxes, Fire and Life Insurance		Interest, Amortization Taxes, Fire and Life Insurance and Reserve	
Period of Amortization, yr.	15	30	25	30	15	30
Interest and Amortization	$35.87	$24.30	$23.99	$21.65	$31.32	$18.99
Taxes—at 2 per cent	6.67	6.67	6.67	6.67	6.67	6.67
Fire Insurance	0.63	0.63	0.63	0.63	0.63	0.63
Life Insurance	...	...	3.06	3.06	3.06	3.06
Reserve—$1.00/mo. per $1000	...	...	...	...	4.50	4.50
Total Monthly Payments	43.17	31.60	34.35	32.01	46.18	33.85

interest rate at 4 per cent or below, with a condition that the owner protect the mortgage by life insurance assigned to the bank, and at even a lower interest rate if the mortgage is covered with insurance plus a monthly payment of $1 per thousand of the mortgage at the time of purchase.

Other statistics developed by Professor Voss show that the total monthly payment necessary to carry each $1000 of indebtedness at various times and under different conditions of protection. The value that could be expected should an owner wish to sell his entire holdings is very interesting. At the end of 15 years (with life insurance and reserve included) about $4600, and at 30 years about $5300.

In summary, Professor Voss answered the question "How can we get low-cost housing?" about as follows:

"The community must control land exploitation, must revise codes and be willing to contract on taxes according to some plan. Over the periods all financial institutions must lower their interest rate proportionately to the reduced risk. Manufacturers and materials men must revise their dealer setup and reduce prices on quantity purchases. Labor must increase their productive effort, remove intertrade restrictions and be willing to consider lower hourly rates on basis of guaranteed annual employment.

"If a great number of local groups operating under this plan were able cooperatively to purchase and distribute the material, it would be possible to reduce unit cost, create annual employment and increase the scope of the market. It would also be possible by reuse of panels between corporations and locally, to gradually reduce costs until lower groups are reached."

Successful Symposium on Effect of Low Temperatures on Materials

Two very interesting sessions comprised the meeting in Philadelphia on March 19 at the Franklin Institute, at which there was held a Symposium on the Effects of Low Temperatures on the Properties of Materials. The Philadelphia District Committee, of which L. E. Ekholm, Climax Molybdenum Co., is Chairman, had arranged through a Program Committee, headed by A. O. Schaefer, The Midvale Co., with G. E. Landt, Philadelphia Textile Finishers, Inc., and F. B. Foley, The Midvale Co. as Co-Chairmen, to have papers presented by outstanding authorities covering plastics, rubber and rubber-like materials, and ferrous and non-ferrous materials, including weldments. The complete program follows:

Afternoon Session—3.30 p.m.

Technical Chairman: G. E. Landt, President, Philadelphia Textile Finishers, Inc.

Low Temperature Behavior of Organic Plastics—H. K. Nason, Director of Development, Central Research Labs., Monsanto Chemical Co., Dayton, Ohio.

Behavior of Elastomers at Low Temperatures—J. W. Liska, Chemical and Physical Research Labs., Firestone Tire and Rubber Co., Akron, Ohio.

Evening Session—8.00 p.m.

Technical Chairman: F. B. Foley, Superintendent of Research, The Midvale Co.

General Aspects of Effects of Subatmospheric Temperatures on the Properties of Metals—Maxwell Gensamer, Professor of Metallurgy and Head, Department of Mineral Technology, Penn State College, State College, Pa.

Effects of Subatmospheric Temperatures on the Properties of Non-Ferrous Metals—Norman L. Mochel, Manager, Metallurgical Engineering, Westinghouse Electric Corp., Philadelphia, Pa.

Effects of Subatmospheric Temperatures on Weldments—Robert D. Stout, Welding Research, Department of Metallurgy, Lehigh University, Bethlehem, Pa.

There was a representative attendance at the two sessions with some 200 present at night, many of whom came from some distance to hear the papers and discussion.

Following a brief statement at each session by Mr. Schaefer who spoke of the need for authoritative data, the technical chairmen introduced the speakers. The papers by Messrs. Nason and Liska include a great wealth of information and data; at the same time the speakers drew attention to certain fields, for example, dynamic properties at low temperatures, in which research is definitely needed. Mr. Liska described various instruments used which permit a comparison of various types of elastomers. Dr. Gensamer gave a fundamental discussion of the relationship of various properties, and questioned whether the measurements we are making now are really giving us the correct answers. There was agreement, however, that for the time being the notched bar impact test is the best we have, but that still more work should be done.

Mr. Mochel in his short, succinct summary, referred to the great value of the report on Properties of Metals at Subatmospheric Temperatures, by H. W. Gillett, in which there are valuable data on impact resistance and tensile properties, and also to earlier papers, notably one by Cyril Smith providing data on copper and other non-ferrous metals.

Mr. Stout described some of the interesting work at Lehigh, pointing out that so far the technique of welding, the type of welding rod, speed of operation, etc., would not seem nearly so influential as the nature and composition of the base metal. He covered the various types of specimens they are using.

The Society is planning to publish the papers and discussion.

Officers on Pacific Coast

As THIS BULLETIN nears press, information has been received of two interesting meetings, one in Los Angeles on March 19, the other in San Francisco on March 25, at which President J. R. Townsend and Executive Secretary C. L. Warwick were the chief speakers. Sponsored by the respective districts in Southern and Northern California, the meetings have given the growing number of members on the Pacific Coast an opportunity to learn at first hand of many of the newer A.S.T.M. activities and also to hear President Townsend give his interesting discussion on "Research Revolutionizes Materials."

News accounts of these meetings will appear in the May BULLETIN.

Outstanding Symposium on Ultra-High Voltage and High-Speed Radiography Held Under Auspices of Committee E-7

A.S.T.M. Committee E-7 on Radiographic Testing presented an outstanding Technical Program in Cleveland on Friday, February 8, 1946. This program, carried out as part of a three-day series of radiographic meetings, two days of which were under the guidance of the American Industrial Radium and X-ray Society, was notable in that it attempted to bring together in a symposium presentations of the most advanced developments in radiography. The meeting was of the nature of a symposium devoted to "Ultra High Voltage and High Speed Radiography." The outstanding men in these developments presented the papers. Arrangements for the symposium were carried out by Committee E-7 Chairman, Dr. H. H. Lester, Watertown Arsenal, with the cooperation of other officers of the committee and of its advisory group. The symposium was held in two sessions, morning and afternoon, with upwards of 250 present at each.

Dr. D. W. Kerst, University of Illinois, talked upon his "Betatron." This instrument is capable of producing radiation equivalent to that generated by X-ray tubes operating at voltages up to and beyond one hundred million volts, although no such potentials are actually applied to the equipment. Radiography with such radiations has not been possible heretofore. The field of their practical application is almost unexplored. The promise of useful industrial results is very great. For example, mechanisms can be examined by this device for the functioning of otherwise hidden parts. Pictures can be obtained of heretofore unapproached precision. Dr. Kerst's presentation met an enthusiastic reception.

Another leader in the same field and who was closely associated with Dr. Kerst in the early phases of the "Betatron" development, was Dr. E. E. Charlton of the General Electric Research Laboratory. He spoke also on phases of the "Betatron" development and, in addition, brought out the characteristics of the two million volt resonance transformer type of equipment. This equipment seems to be ideally suited for radiographic inspection where large volume of output is necessary and where very high fidelity radiographs are needed. In comparison with the similar type one million volt equipment, the two million volt is about ten times more powerful and gives pictures with better background. Dr. Kaiser of the Naval Research Laboratory summed up the European developments in the Betatron field. It appears that while the idea of magnetic acceleration of electrons to replace electrostatic acceleration in the conventional X-ray tube originated in Germany, the development of the equipment for practical exploitation of the idea has progressed much further in this country than in Germany. So today it would appear that due largely to Dr. Kerst and Dr. Charlton America leads the world in the development of this type of equipment.

Another type of equipment of very high potential value was described by Dr. W. W. Buechner, who was associated with Professor Van de Graaff, of Massachusetts Institute of Technology, in this development. This machine utilizes a static generator to build upwards of two million volts across a conventional type X-ray tube. This d.-c. potential yields X-rays from almost a point source that have remarkable radiographic properties. All three of the new types of X-ray equipment have possibilities for industrial applications that are as yet almost unexplored.

A fourth type of equipment was described by Dr. C. M. Slack of the Westinghouse Electric Corp. This machine is designed to make instantaneous radiographs. It is possible with it to picture a bullet in flight, or projectile traveling down a gun tube or a bursting projectile, or details of the burning of a powder charge. Such pictures have been heretofore impossible. In this case also the field for industrial application has hardly been scratched.

In addition to the above-mentioned principal papers there were various supporting papers by Lt. D. T. O'Connor, USN, Ordnance Investigation Laboratory, Naval Powder Factory; H. F. Kaiser, Naval Research Laboratory, and E. R. Thilo, Frankford Arsenal, who have been using the various types of equipment in practical investigative work. It was evident from these papers that these new machines have been advanced in design and construction to points of practical utility.

All of the above developments represent wartime engineering achievement that have only recently become available for general exploitation.

It is planned to issue these papers together with the rather extensive discussion presented at the two sessions in the form of a symposium book. Further announcement will be made concerning this publication. It should be of widespread interest, as have been the several other technical publications resulting from the intensive activity of Committee E-7, including the first Symposium on Radiography and X-ray Diffraction Methods held in 1936, and the 1943 Symposium on Radiography.

In connection with the 100th Anniversary of the Birth of Wilhelm Konrad Roentgen and the 50th Anniversary of the Discovery of X-rays, General Electric Co. issued a pamphlet entitled "The Story of X-ray" and in this included among a large number of interesting illustrations the above radiograph of a flower. Making these is a hobby followed by some of the radiologists.

Many Technical Developments at A.S.T.M. Committee Week

Some 200 Meetings of Committees in Pittsburgh

Many important developments in the work on standards and research in materials were discussed and acted on at the some 200 meetings of A.S.T.M. Technical Committees held in Pittsburgh during Committee Week extending from February 25 through March 1. As a result of the discussions a large number of new tentative specifications and tests will be referred to the Society, and many of the committees have important changes to make in existing specifications; also a number of new research programs were planned.

This series of meetings, the first since 1944 when the Committee Week was held in Cincinnati, demonstrated the intense interest in the whole materials field, and it is evident the Society has one of its busiest years ahead. While most of the recommendations will come up for action at the Society's Annual Meeting at Buffalo in June, many of them will be acted upon promptly and will be issued in the next several weeks.

While the total registration for Committee Week was 908, the second highest since these series of meetings were inaugurated, attendance is quite variable depending upon how many of the larger committees chance to meet during the week. Some hold their meetings at other locations at different times.

In the accompanying box is a list of the main technical committees which convened in Pittsburgh and there are also listed several committees which have met recently at different locations.

In line with the usual practice of requesting officers of the technical committees to supply information on the major developments at the committee meetings and using this material as the basis for news accounts in the Bulletin, there appears on the following pages information which it is believed will be of interest to many of the members. There was intensive activity at all of the meetings and a review of the developments as indicated below will make clear to those concerned just how much activity is under way in the fields of standardization and research. These accounts cover not only meetings held in Pittsburgh during Committee Week but several groups which have met recently in other cities.

For the most part all of the recommendations noted will be referred to the various committees for letter ballot before formal recommendation to the Society and this situation should be kept in mind in reviewing the proposed actions. Members will be given further information through the preprints of reports which will be distributed this year, as previously, in advance of the Annual Meeting, these reports covering the many actions which committees will bring up at the Annual Meeting in Buffalo, June 24 to 28.

List of Committee Meetings

- A-1—Steel
- A-3—Cast Iron
- A-5—Corrosion of Iron and Steel
- A-10—Iron-Chromium-Nickel and Related Alloys
- B-1—Wires for Electrical Conductors (New York, N. Y., Feb. 15)
- B-3—Corrosion of Non-Ferrous Metals and Alloys
- B-4—Electrical-Heating, Electrical-Resistance, and Electric-Furnace Alloys (New York, N. Y., Feb. 20–22)
- B-5—Copper and Copper Alloys, Cast and Wrought (New York, N. Y., March 11, 12)
- B-7—Light Metals and Alloys, Cast or Wrought
- B-8—Electrodeposited Metallic Coatings
- B-9—Metal Powders and Metal Powder Products (Chicago, Ill., Feb. 27–28)
- C-1—Cement
- C-5—Fire Tests of Materials and Construction (Washington, D. C., March 21)
- C-9—Concrete and Concrete Aggregates
- C-12—Mortars for Unit Masonry (Washington, D. C., March 7)
- C-14—Glass (Subcommittees)
- C-15—Manufactured Masonry Units (Washington, D. C., March 6)
- C-16—Thermal Insulating Materials
- D-1—Paint, Varnish, Lacquer and Related Products
- D-2—Petroleum Products and Lubricants (Cleveland, Ohio, March 17–20)
- D-3—Gaseous Fuels
- D-4—Road and Paving Materials
- D-6—Paper and Paper Products (Subcommittees) (New York, N. Y., March 1)
- D-7—Wood (Chicago, Ill., March 12)
- D-8—Bituminous Waterproofing and Roofing Materials
- D-9—Electrical Insulating Materials (Atlantic City, N. J., March 7, 8)
- D-11—Rubber and Rubber-like Materials
- D-14—Adhesives (Atlantic City, N.J., March 4, 5)
- D-18—Soils for Engineering Purposes
- D-19—Water for Industrial Uses (Pittsburgh, Pa., Feb. 19, 20)
- D-20—Plastics (Atlantic City, N. J., March 6, 7)
- E-1—Methods of Testing (Sections)
- E-3—Chemical Analysis of Metals
- E-4—Metallography (Subcommittees)

Committee A-1 on Steel

The heavily attended series of meetings of Committee A-1 on Steel were featured by rather intensive activity in the fields of structural steel, bar steels both carbon and alloy, and pipe and tubing. Numerous recommendations in other fields covered spring wire, forgings, steel castings, and steel for boilers and pressure vessels.

The Advisory Committee acted to establish a class of Honorary Membership which will recognize the outstanding activities of a number of long-time A-1 members, and approved the complete reorganization of Subcommittee XIII on Methods of Testing. Small sections will be appointed to channel the activities of tension testing, speed of testing, bend testing, interpretation of numerical requirements, etc.

Low-Temperature Applications.—To meet the expressed need for guidance in establishing not only specific require-

ments but tests for materials used at extremely low temperatures, two subcommittees covering boiler and pressure vessel steel and pipe and tubing have appointed special sections to develop information and data.

Structural Steel.—There was intensive discussion of a specification to cover structural steel for welding, and instead of attempting to set up carbon and manganese limitations in the widely used Specification A 7, an attempt will be made to draft a separate specification which eventually might replace A 7. The present physical properties are to be retained in the specifications for low-alloy structural steel (A 242). These are such as to justify a design stress of 27,000 psi. Because of confusion which would result if requirements on rivets of similar composition and strength were incorporated in this specification, a separate document will be drafted.

Two new specifications for carbon steel plates were approved for submission to letter ballot, one to cover material over 2 in. in thickness with a special silicon content, intended for use for machine parts and general construction by gas cutting, welding, or other means. The companion specification covers material 2 in. and under. These eventually will replace existing specification A 10 for Mild Steel Plates, 55,000 to 65,000 psi. tensile strength, and A 78, Low Strength Plates for Welding. As a result of recommendations from the American Iron and Steel Institute, revised tables covering permissible variations will be embodied in the plate and structural specifications.

Bar Steels.—Proposed revisions of existing specifications for commercial hot-rolled bar steels (A 107) and cold-finished material (A 108) had been published in 1944. These changes brought up to date tables of chemical compositions, permissible variations in check analysis and in particular include an appendix of useful information on characteristics, applications, and minimum tensile strength values of the grades covered. Following favorable letter ballots, these revisions will be incorporated in the standards.

Perhaps of particular interest was the approval of a specification which is expected to be the forerunner of several others providing specified physical requirements as well as chemical properties of various types of bar steels. The first, one covering alloy heat-treated steel bars, sets up several grades of quenched-and-tempered material ranging in tensile strength (depending upon size) from 95,000 to 125,000 psi. Representative chemical compositions are the 2300, 3100, 4100, and 8700 series. Under development are other standards to cover hot-rolled, annealed and heat-treated carbon bars subject to tensile requirements.

Steel Castings.—Just published by the Society are new tentative specifications for steel castings, one of which, A 281, mild to medium strength material, is a consolidation of three existing standards, A 27 miscellaneous, A 87 railroad, and A 215 welding, while the other one, A 282, covers high-strength castings. The committee in charge is very anxious that the older designations be applied and is moving to insure that the mild to medium specification will carry the old designation A 27, and the high strength continue with A 148. These designations are so ingrained in the industry that their retention is considered desirable. Some changes were approved in the physical requirements for high-strength material, providing slight reductions in ductility in the very high strength grades.

Steel Pipe and Tubing.—A notable recommendation approved in this field was the withdrawal of virtually all of the emergency alternate provisions which had been introduced not only in the interest of conservation of critical alloying elements, but also to expedite production. The committee in charge felt it best to canvass those concerned with production and use before proceeding too rapidly, but now is revising numerous pipe and tubing requirements, in many cases to prewar chemical and physical requirements, but in a number of cases incorporating a number of practices which were set up as emergencies.

In 13 pipe specifications a set of formulas will be incorporated covering the elongation requirement for strip tests where specimens are cut from material less than $\frac{5}{16}$ in. in thickness. In certain of the tube standards covering steel, boiler and superheater, the values for permissible manganese are being raised.

A survey indicated that three specifications previously issued through joint work with Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys, covering various types of ferritic and austenitic stainless steel tubing for general service, and for the dairy and food industry (A 268, A 269, A 270) are widely used, but a companion specification A 271, covering still tubes is apparently not in general use. Reasons for this are to be studied in an effort to insure that the benefits from the standardization program on still tubes may become more widely effective.

Spring Wire.—Tentative revisions in the widely used standard specifications for music wire (A 228) are to be published which will provide a more rational set of tensile strengths based on wire diameter. The committee has worked out a formula which enables the values to be computed, resulting in a straight line plotting. Proposed average tensile strength requirements would range from 462,000 psi. (wire diameter of 4 mils) to 264,000 psi. for 156 mil material.

Steel for Pressure Vessels.—A new specification combining existing standards A 70 and A 89 carbon steel plates of flange and fire-box quality for boilers was accepted. It covers material up to 2 in. in thickness and provides three grades, 60,000, 65,000, and 70,000 psi. minimum tensile, with corresponding yield points of 24, 27, and 30 per cent minimum.

Committee A-3 on Cast Iron

Several subcommittee meetings of Committee A-3 were concentrated on Monday with a meeting of the main committee on Tuesday of A.S.T.M. Committee Week. Eight subgroups reported. Although no changes of a substantial nature were recommended in the widely used specifications for Gray Iron Castings (A 48), a number of editorial clarifications are to be submitted. These specifications which established seven classes of material ranging in strength from 20,000 to 60,000 psi., respectively, were reapproved in 1944 without change.

Based on rather intensive studies, there was issued in 1944 a tentative covering Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 F. (A 278). The subcommittee concerned is now carrying out studies of requirements for material which would be still suitable for high-temperature service but where no pressure requirements would be involved.

The Chairman of the Committee, Dr. J. T. MacKenzie, has been developing and compiling data on the relationship of Brinell hardness and strength, which data and discussion will be presented as a technical paper or report at the June Meeting of the Society in Buffalo.

The subcommittee responsible for nomenclature and definitions in this field has developed proposals covering inoculants, chilled iron, and types of graphite and after approval these will be incorporated in the existing Tentative Definitions A 196.

Two existing tentatives, A 256, Compression Testing and A 260, Torsion Tests, are to be recommended for adoption as standard.

(*over*)

Committee A-5 on Corrosion of Iron and Steel

In connection with the long-time work of Committee A-5 on Corrosion of Iron and Steel, which has functioned actively since 1906, it was noted that October 17, 1946, would be the thirtieth year for the continuous exposure of copper-bearing and noncopper-bearing black sheets at the famed Annapolis tests. These are probably the longest series of continuous tests with inspection reported every year by several of the same observers. One of the notable developments from the tests was conclusive evidence of the improved effectiveness of copper-bearing over noncopper-bearing steels in resisting atmospheric corrosion.

It was announced that the final report of the extensive immersion tests of copper-bearing and noncopper-bearing products in sea waters will be submitted at the June A.S.T.M. Meeting. The report will include a paper comprising an extensive analytical discussion, which is being prepared by V. V. Kendall, National Tube Co., Pittsburgh.

Specifications

In its work on specifications, the committee reviewed most of the items and reaffirmed them, but the standard for zinc-coated iron or steel sheets, A 93–27, is to be withdrawn and replaced by the tentative existing since 1938. The tentative will include some of the explanatory material formerly appearing only in the standard.

Since the issuance of the former Emergency Specifications for Lead Coating on Iron or Steel Hardware, which are now published as A.S.T.M. Tentative A 267, there has been sufficient trial to indicate some possible fields of usefulness in a peacetime economy. The specifications are to be continued with some slight modifications. With the potential easing of the tin situation improvements can be incorporated.

Another active development in the committee involves the somewhat complicated one of agreeing on specifications for long terne sheets. Such material is used widely in lanterns, as liners of gasoline tanks and also where the property of lead coating as a lubricant in connection with drawing operations is of value. Terne coatings have particular value also where painting or some similar protective coatings are to be applied.

Some years ago when there was considerable concern with respect to the reported embrittlement of galvanized structural steel, the committee, after very extensive research investigation, drew up a Recommended Practice for Detecting and Safeguarding Against Embrittlement, A 143. The studies were based on steel having a tensile strength range of 55,000–65,000 psi. At the time of the investigation, these tensile requirements were common to both specifications A 7 on Steel for Bridges and A 10 on Mild Steel Plates. Before issuance of the Embrittlement Practices, the tensile requirements in the A 7 specifications were raised to 62,000–72,000 psi., so the practices were issued to apply to the A 10 grade of steel only. Later experience has shown that the practices also safeguard against embrittlement of the 62,000–72,000 psi. grade of steel so the practices are being revised to refer to the widely used A 7 specifications.

Tests

In the work on methods of test two general lines of study are involved: first, field conformance tests for inspecting coatings which are in general nondestructive; and the second, tests represented by stripping and Preece tests. Field conformance procedures are intended to provide a quick evaluation of the quality of the coating, of which acid-dropping or magnetic test methods are representative. While these are not yet precise enough in the opinion of some to justify publication as tentative standards, they in general are accurate to about 15 to 20 per cent for some kinds of coatings, and for others can give a closer evaluation.

The very extensive field tests of metallic coatings, which the committee has under way from coast to coast at numerous test sites, involve broadly three materials: zinc-coated sheets; coated hardware with various coatings and shapes; and wire and wire products of a considerable variety. In the wire tests exposed some nine years ago there were over 900 samples at each of the 11 locations. The general results of the exposure show the destruction of all but the heaviest coatings at the severe locations, with no significant corrosion, even on the lighter coatings, at the mildest corrosion sites.

In connection with coated hardware tests the committee is beginning to think about another series of tests of coatings which tests would involve fewer shapes but prepared with coatings whose characteristics would be more precisely known.

Committee A-6 on Magnetic Properties

(Meeting in Philadelphia)

The meeting held in Philadelphia on March 20 was the first convened by Committee A-6 since 1944. Many items relating to the magnetic testing standards which had accumulated were discussed at some length and appropriate actions were taken. Included in these items were the methods of determining ductility of electrical sheet and strip materials, tolerances in the dimensions of magnetic test specimens, the determination of electrical resistivity, and several other details of technique in magnetic testing. Reports on a round-robin test at frequencies higher than power frequencies were presented and discussed. In view of the excellent agreement obtained between the different laboratories it seems feasible to proceed with the formulation of specifications for such tests.

In view of the fact that factors other than the strictly magnetic properties of materials have a definite bearing on their performance the committee has felt justified in specifying appropriate methods for the determination of such characteristics as resistivity, space factor, interlamination resistance and ductility. For this reason, it was voted that the necessary steps be taken to modify the title and statement of scope of the committee so as to conform more nearly with actual practice. The committee also took steps to improve the coordination with other committees dealing with subjects in which the committee has a legitimate interest.

Committee A-10 on Iron-Chromium-Nickel and Related Alloys

Committee A-10 has reported that agreement had been reached with the Alloy Castings Institute on data to be published on alloy steel castings. This will be similar in form to the well-known tables of data on corrosion-resisting steels published by A.S.T.M. in in 1942. The new data on castings will be circulated to the committee for final comment and publication of the material in June is expected.

The subcommittee on methods of corrosion testing has arranged for a symposium to be held at the A.S.T.M. Annual Meeting in June which will consist of seven papers and will outline past experience with corrosion-resisting steels. The subcommittee also has completed details of a plan for a new 15-yr. exposure test of corrosion-resisting steels which, after final review by members of the entire committee, will be started during the summer. A modification of the method for boiling nitric acid test for corrosion-resisting steels is being reviewed and may be completed in time for the June meeting of the committee. It is expected that information on passivation of stainless steels will be

published in the ASTM BULLETIN shortly.

Subcommittee VI on Metallography has under consideration the formulation of a program for the cooperative study on the nature of the sigma phase in iron-chromium-nickel alloys. Methods of identification, including metallographic, will be worked out in cooperation with Committee E-4 on Metallography.

In the work on wrought products agreement was reached on changes in Specification A 276—Hot-Rolled and Cold-Finished Corrosion-Resisting Steel Bars. A new specification for stainless steel spring wire of the 18–8 type has been started and development work is under way on a specification for corrosion-resisting steel billets for reforging.

Subcommittee IX on Specifications for Flat Products has reviewed all its existing specifications and is making numerous changes in the chemical requirements of a number of alloys to eliminate traces of wartime restrictions and emergency alternate provisions no longer required.

The subcommittee on castings is drafting one or two specifications for corrosion-resisting alloys for general use. These specifications could be used as a basis for specifications for special applications of like material.

Committee E-3 on Chemical Analysis of Metals

During the meetings of Committee E-3 a number of important revisions and new methods were considered that will be published in the 1946 Book of A.S.T.M. Methods of Chemical Analysis of Metals (available in the early summer). Of particular interest are six new tentatives covering photometric methods for the analysis of non-ferrous metals and alloys. These methods have been prepared in a new and comprehensive style which should find especial favor with the analyst. They have been grouped in a separate section introduced by a recommended practice for photometry which presents a discussion of the many factors of special significance in photometric work. The new tentatives include: Recommended Practice for Photometric Methods for Chemical Analysis of Metals; Photometric Methods for Chemical Analysis of Magnesium-Base Alloys, which contain procedures for manganese, iron, copper, silicon, and lead; Chemical Analysis of Copper and Copper-Base Alloys, which contain procedures for nickel, phosphorus, iron, and manganese; Determination of Iron in 70–30 Copper-Nickel Alloys; Determination of Iron in Slab Zinc (Spelter); Determination of Iron in Lead- and Tin-Base Alloys; and Determination of Bismuth in Pig Lead.

Polarographic procedures for lead and cadmium in slab zinc (spelter) and for zinc in lead- and tin-base alloys are being introduced. These represent the first ventures by Committee E-3 into the field of polarography. Wherever they are applicable these procedures offer considerable promise of increased accuracy with appreciable saving of time.

Revisions in the Tentative Recommended Practices for Apparatus and Reagents for Chemical Analysis of Metals (E 50) include the addition of requirements for apparatus (1) for the determination of sulfur by direct combustion, (2) for nitrogen by distillation, (3) for polarographic analysis, and (4) for storing titanous chloride solution under an atmosphere of hydrogen. A table of stoichiometrical equivalents of standard solutions and requirements for standard titanous chloride solution are also being added to E 50.

The Standard Methods of Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron (E 30) so widely applied throughout the metals industry, have been revised and expanded to provide among other items that they may include a procedure for selenium. New methods are being published covering the determination of sulfur by direct combustion, and of nitrogen, in steel. The accuracy of the proposed combustion method for sulfur compares favorably with that obtainable by the older and longer gravimetric procedures used hitherto. The time required is remarkably short, since a complete determination can be made in 20 minutes. The procedure for determination of nitrogen fills a gap which has existed for a number of years in analytical methods for steel.

The Methods of Chemical Analysis of Ferro-Alloys (E 31) have also been considerably revised, including a complete revision of the procedure for determining phosphorus.

As a result of the study of more detailed methods of sampling metals for chemical analysis, now being made in Committee E-3, the Methods of Sampling Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron have been removed from A.S.T.M. Standard E 30 and established as a separate standard. Tentative Methods of Sampling Slab Zinc (Spelter) are being submitted to letter ballot of the committee. The Methods for Sampling Wrought Non-Ferrous Metals for Chemical Analysis which appeared in draft form in the 1943 Book as information have now been approved as tentative.

A method for the Determination of Iron by the Titanous Chloride Method is being added to the Methods of Chemical Analysis of Aluminum and Aluminum Alloys (E 34).

The former Methods of Battery Assay of Copper (B 34) have been revised and reissued as the Methods of Chemical Analysis of Copper (Electrolytic Determination of Copper), which are now applicable to copper having a purity of 99.40 per cent and over.

The Methods of Chemical Analysis of Special Brasses and Bronzes have been revised and considerably augmented by addition of procedures covering the determination of iron, phosphorus, nickel, manganese, arsenic, and antimony.

Work is now under way to develop additional methods for copper alloys such as beryllium copper, and for nickel alloys. Additional photometric methods for Chemical Analysis of Aluminum Alloys are being drafted and a method for the determination of boron in steel has been developed.

Committee B-1 on Materials for Electrical Conductors

(Meeting in New York City)

One of the important matters reviewed in detail at the meetings in New York City on February 15 of Committee B-1 was to establish a study group to plan for the enlarged scope of this committee which now is to include all of the common materials used for electrical conductors. Formerly the committee concentrated its work on copper and copper-alloy wires. The committee will be enlarged and several subcommittees are to be formed.

In addition to this activity, the committee received reports of special task groups appointed for the purpose of recommending changes in parts of the present specifications, and considered standards that have stood without revision for six years.

The reports included information on recommendations for methods of tests for determining the actual areas of cross-section of finished stranded conductors, either on a weight or resistivity basis; the edgewise bend testing equipment for soft rectangular and square copper wire; and separate methods of tests for some of the B-1 Specifications.

An augmented task group was appointed to make recommendations to the joint committee reviewing methods of tests for resistivity of the various electrical conductors. Consideration is being given to converting specifications

B 193–45 T from a resistivity basis to a conductivity basis.

Several of the specifications now under the jurisdiction of this committee contain methods of test which can be better handled by separate methods. A study is to be made of all the specifications working toward issuing separate methods of test at which time some of the test procedures are to be amplified.

In reviewing the specifications which have stood six years without revision, it was decided to reaffirm specifications B 105–39 for Hard Drawn Copper and Copper Alloy Wire without change. Specifications B 9–39, Bronze Trolley Wire and B 47–39, Copper Trolley Wire may need some revision and a task group was appointed for the purpose of reviewing these specifications and reporting back at the next meeting.

Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys

Although Committee B-3 has had extensive series of tests under way for many years, on account of conditions prevailing during the past four or five years some lines of proposed study have been held in abeyance. At the Pittsburgh meetings there was extended discussion of the whole field of activity embraced in the committee's work. With new conditions obtaining, active study has been proposed in one line, the correlation of weather with atmospheric corrosion. While this might seem to be only of theoretical interest, it has its practical features. The choice of the right kind of non-ferrous metal for various types of outdoor service is closely related to the corrosive agencies which help to constitute the "weather." The work is to be prefaced by a survey by a small group to determine the factors which constitute weather in a number of selected environments, possible methods for their study and determination of the availability and suitability of instruments for the purpose.

Study of "galvanic" or electrolytic corrosion in atmospheric service has continued active. A subcommittee is actively engaged in preparing electrolytic couples for the study of magnesium when coupled to other common metals. Plans were perfected for obtaining all the various metals with the help of a number of manufacturers, and it is anticipated that the assembled couples will be placed during the summer for exposure at four typical locations. Efforts are being made to obtain one site representative of tropical climate. The work necessitates extensive cooperation of B-7 on Light Metals and Alloys. The subcommittee will bring in for test, couples of stainless steel with other metals which have been exposed five years to the industrial, marine and rural atmospheres. It is planned to exhibit these test specimens at the Annual Meeting in Buffalo in June.

The salt spray test (B 117) has continued to be extensively used by industry, and a subcommittee is engaged in determining the factors essential in this test and so that complete uniformity and consistency in testing by various testing engineers will be possible. Requests from industry indicate the desirability for developing a controlled humidity corrosion test. Favorable action was taken on this subject. Corrosion resulting from humidity during the war years in the tropics proved very excessive. Certain industrial applications relate to refrigerators, air conditioning and building insulation, in general.

The Subcommittee on Total Immersion Corrosion Tests approved changes which would make the Recommended Practice on Plant Corrosion Tests (A 224) developed originally for corrosion-resisting alloys, applicable to the testing of non-ferrous metals.

The Subcommittee on Statistical Analysis and Planning of Corrosion Testing will continue to aid other subcommittees in planning tests so that data obtained may be treated statistically and will consider the preparation of a simple outline procedure for applying statistics to corrosion tests.

For Committee B-4, see page 70

Committee B-5 on Copper and Copper Alloys, Cast and Wrought

(Meeting in New York)

Committee B-5 held a well-attended meeting at the Hotel Woodstock in New York City on March 11 and 12. In addition to the meeting of Committee B-5, there were meetings of the four subcommittees dealing with wrought products, the subcommittee on castings and ingot, the subcommittee on methods of test and the Advisory Committee.

Recommendations were made for changes in many of the specifications under the jurisdiction of the committee, among the more important of which were the following:

The Subcommittee on Plate, Sheet, and Strip has voted to add in the Appendix for the eight general specifications for these products a Table of preferred thicknesses based on ASA Standard B32.1. The proposal to add the same table to eight other specifications for specific or special products was rejected. Minor changes were recommended in a number of other specifications.

The Subcommittee on Rods, Bars, and Shapes voted to eliminate the present Emergency Alternate for Free-Cutting Brass Rod (EA-B 16) without incorporating the wider limits for impurities permitted therein in the basic Specification B 16, but some changes in the table of tensile properties of this specification were approved. Chemical limits for two types of aluminum bronze rods, bars, and shapes (B 150) were established corresponding to the two types now covered in the tensile requirements of the same specification. The Subcommittee on Wire and Wire Rod is recommending several changes in specifications under its judrisdiction, most of these being in the Specification for Brass Wire (B 134).

The Subcommittee on Pipe and Tube voted to delete from the Specification for Copper Water Tube (B 88) the 1/8 and 1/4 in. sizes in all three types, K, L and M and all sizes of type M copper water tube, 2 in. in diameter and under. In the Specification for Brass Pipe, Standard Sizes (B 43) it was voted to delete the requirements for all alloys except red brass. All the subcommittees on wrought products in reviewing their specifications are looking to the application thereto of the provisions for the interpretation of the numerical data contained in the recommended practices for Designation of Numerical Requirements in Standards (E 29).

The Subcommittee on Castings and Ingots for Remelting voted to set up a task group to study the subject of test bars and test bar practice which will review the work currently being done on this subject at Battelle Memorial Institute under the sponsorship of the Non-Ferrous Ingot Metal Institute; the work on the same subject at the Naval Research Laboratory and the British Standards Institution Code of Procedure in Inspection of Copper-Base Alloy Castings which was recently published in England. The subcommittee also voted to remove all detailed requirements for test bars now shown in its standard specifications and emergency alternates and place them in a separate recommended practice to be developed, which will later be expanded as the first task group referred to above has recommendations to offer.

The Advisory Committee assigned to the Editorial and Publications Subcommittee the preparation of standard definitions of terms relating to copper and copper-base alloys; the development of a classification for wrought alloys similar to the classification of cast cop-

per-base alloys (B 119) developed by the committee in 1940; and the coordination of phraseology and nomenclature in all B-5 specifications.

Committee B-7 on Light Metals and Alloys, Cast and Wrought

During the war the Armed Forces were using practically all of the aluminum and magnesium that could be produced. As a consequence, a very small percentage of these metals was being procured on specifications not directly connected with Army and Navy requirements. Hence, when the members of Committee B-7 on Light Metals and Alloys, met in Pittsburgh during A.S.T.M. Committee Week, they tackled the major task of bringing the A.S.T.M. specifications for these materials up to date to include all the latest new alloys and alloy developments that had taken place during the past few years.

This activity will be particularly pronounced in Subcommittee III on Wrought Aluminum Alloys and Subcommittee II on Aluminum Alloy Castings both of which have an extensive program to bring the specifications up to date. Plans were also laid for writing specifications for magnesium alloy tubing.

The Pittsburgh meeting was characterized by the active participation of new producer and consumer interests which have recently been added to the committee rolls and are now taking part in the work of the committee for the first time.

Subcommittee VI on Anodic Oxidation of Aluminum and Aluminum Alloys reported that a new nondestructive method of test for anodic coatings had been developed by the Naval Research Lab. and plans are being made to evaluate this further before drafting a proposed standard A.S.T.M. test. Plans were also made by Committee B-7 to cooperate with Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys in a test program for the light metals.

At the suggestion of the foundry division of the Aluminum Association and of the Aluminum Research Institute a review is being made of the standard system of nomenclature for wrought and cast aluminum alloys, and Subcommittee VII is cooperating with them.

Committee B-8 on Electrodeposited Metallic Coatings

At the Pittsburgh meetings of A.S.T.M. Committee B-8, one of the important matters discussed was the behavior of the tests of lead coatings on steel which have been on exposure at four test sites for approximately two years. The exposure results to date will be included in the annual report. The subcommittee responsible for these tests of performance also presented its program for a research investigation of copper-nickel-chromium coatings on high-carbon steel. The first group of test panels has been prepared and placed on the various exposure racks.

Subcommittee V, which is concerned with supplementary protective finishes for metallic coatings, discussed plans for evaluating various supplementary coatings, such as chromate and phosphate types on zinc and cadmium surfaces and appointed a subgroup to collect available data on the subject and to prepare a suitable program of tests.

Another action taken by the committee to insure uniformity, proper form, etc., in its specifications and reports, is to reorganize the subcommittee which formerly was concerned with specifications and definitions to be an editorial group to which the other working groups will submit material for publication. The group will also be concerned with the solicitation of suitable technical papers for presentation at the meetings.

Committee B-9 on Metal Powders and Metal Powder Products

(Meeting in Chicago)

Committee B-9 on Metal Powders and Metal Powder Products held its meeting in Chicago in connection with the A.I.M.E. Annual Meeting which included in its program a symposium on the subject of metal powders. While this A.S.T.M. committee was organized only two years ago, it has already completed a number of items of work and has many active projects in hand.

Subcommittee I on Nomenclature and Technical Data has been working on a glossary of terms and definitions used in the industry. It has agreed on proposed definitions for 115 items which will be included, but still has minor adjustments to be made in 17 others before the lists will be published. This subcommittee is also working actively on a project to develop standard test bars for powdered metals and has tentative designs of a flat, as pressed, specimen as well as for a round machined specimen. Sketches of these are being sent to members for comment, after which tests will be run in various laboratories to correlate test data secured in using them.

Subcommittee II on Metal Powders has developed four test methods: namely, sampling, screen analysis, apparent density, and flowability, and is working on three others—compressibility, subsieve particle size analysis, and chemical analysis of powders. The last-named method will involve determination of hydrogen loss, total iron in iron powder, and the total content of insoluble matter such as silica, etc.

The work of Subcommittee III on Metal Powder Products as reported by the various sections of this subcommittee is as follows: Section I on Bearings discussed additional information which may be added in an appendix to Specification B 202 for Metal Powder Sintered Bearings (Oil Impregnated). Section II on Structural Parts has arranged for some preliminary studies which are necessary before any specification work can be undertaken. Section III on Cemented Carbides is working on the development of methods of test for transverse rupture, hardness, quantitative analysis, grain size, flaws (internal and external) and service tests such as machining. Section IV on Electrical Parts is developing test methods for the evaluation of magnetic permeability of pole pieces and for the resistivity of electrical contacts. Section V on Friction Materials reported progress in their discussions concerning preliminary standardization of their materials.

Committee C-1 on Cement

At its well-attended meeting in Pittsburgh Committee C-1 on Cement approved the following three recommendations affecting standards:

1. To revise the Standard Specifications for Portland Cement, C 150–44, by adding to Table I on Chemical Requirements a footnote providing that the maximum limit for sulfur trioxide content for Types I and III cements be 2.5 and 3.0 per cent, respectively, when the tricalcium aluminate content is greater than 8 per cent.

2. To revise the Tentative Specifications for Air-Entraining Cement, C 175–44 T, by adding to Table I a footnote providing that the maximum limit for sulfur trioxide content for Type IA cement be 2.5 per cent when the tricalcium aluminate content is greater than 8 per cent.

(Recommendations 1 and 2 represent an increase of 0.5 per cent in the allowable maximum limit for sulfur trioxide content when the tricalcium aluminate content exceeds 8 per cent.)

3. To adopt as standard Sections 2 to 10, inclusive, of the Tentative Methods of Chemical Analysis of Portland Cement, C 114–44 T. These sections include a rapid alternate method for sodium oxide and potassium oxide, a

method for sulfide sulfur, and the alternate method of rapid determination by turbidimeter for sulfur trioxide.

Numerous progress reports were presented by the various subcommittees. A very interesting report covered many details of the study which is now being made of the extensive data secured by a group of laboratories in an investigation of important factors relating to the compressive strength test of mortars. Two of the subcommittees reported on current studies of flow table questions. There were also extensive summaries of work on the use of the lean mortar bar test for sulfate resistance, and on the effects of alkalies in portland cement on the durability of concrete. Mr. William Lerch of the Portland Cement Association presented a well-illustrated talk on the Effect of SO_3 Content of Cement on the Durability of Concrete.

Committee C-9 on Concrete and Concrete Aggregates

While the meetings of the several subcommittees and the main group of Committee C-9 on Concrete and Concrete Aggregates were essentially of a reorganization nature, nevertheless a number of interesting actions were taken. There was heavy attendance of those concerned with the production and use of aggregates and concrete. The committee announced satisfactory progress in its plans for a Symposium on Durability of Concrete to be held during the A.S.T.M. Annual Meeting in Buffalo the week of June 24. W. F. Kellermann, of the Federal Public Roads Administration, is Chairman of the Symposium Group, and serving with him are: R. E. Davis, University of California; Floyd B. Hornibrook, Master Builders Research Laboratories; and K. B. Woods, Purdue University.

Two new subcommittees are being organized to investigate methods of test and perhaps eventually to develop specifications—the first on admixtures in concrete; and another on the reactivity of aggregates with alkalies.

Revisions are in preparation in the Standard Test for Structural Strength of Fine Aggregate (C 87) with attendant changes in the Specifications for Concrete Aggregates (C 33) which will, in effect, limit the scope of the tests with respect to determining harmful impurities, and consequently will no longer be an acceptance test for sands that are suspected.

The committee will develop in consultation with A.S.T.M. Committee C-1 on Cement a definition for admixtures. It has studied revisions in the definitions for sand, with the following proposal to be recommended:

Sand.—The fine granular material usually smaller than $\frac{1}{4}$ in. resulting from the erosion of rock by natural agencies or from the mechanical reduction of weakly cemented sandstone. The term is often used with a qualifying adjective to denote the product of mechanical crushing as, for example, "stone sand" or "slag sand."

Several new studies are to be inaugurated in the general field of methods and apparatus for testing concrete, one of which will involve thermal coefficient of aggregates, which property bears a very tangible relation to the durability of concrete, and in general affects the quality and use of the product. Editorial changes are being incorporated in the slump and the flow tests, C 143 and C 124, respectively.

In work on aggregates, refinements in the procedures will probably be developed in the soundness test. Another new project will involve the identification of aggregate types. A broad term descriptive of this might be "lithological characteristics."

Among the most important specifications developed by Committee C-9 are those covering ready-mixed concrete (C 94). They have been the subject of much study and discussion and have been widely used as such or as the basis for clauses used in general specifications. A complete reexamination of the specifications is now being undertaken.

Committee C-16 on Thermal Insulating Materials

Among the many projects under way in Committee C-16 on Thermal Insulating Materials are studies of the impact test and the measurement of deflection during flexure and at the breaking point of the preformed block.

The committee has completed a new method of test for strength of insulating board made from vegetable fibers. This method was submitted for publication this year.

Specifications for blanket or bat thermal insulation for building purposes are under consideration. The committee is studying and obtaining data on water- vapor transmission and also on fire and flame resistance in order to establish the specific requirements for these properties.

In work on physical properties of loose-fill insulation made from both mineral and vegetable materials a study is being made by producers and consumers to determine the physical properties applicable to this type of insulation and following this the data will be evaluated for use in the establishment of specifications.

The group on thermal conductivity of all forms of insulation, which functions under the sponsorship of A.S.T.M., A.S.H.V.E., A.S.R.E., and N.R.C., has selected three methods of test for determination of conductivity of pipe insulation. Check tests will be conducted by various members and results reported at the next meeting. These data will also serve as the basis for the development of a standard pipe conductometer.

The subcommittee on measurement of thermal properties other than thermal conductivity has under consideration the following properties of thermal insulation: (1) heat capacity or volumetric specific heat, (2) thermal diffusivity, coefficient of thermal conductance, (3) effect of prolonged heating at high temperatures, (4) heat (dimensional) stability at high temperatures, (5) surface emissivity (radiation).

A special committee is being appointed to study the application of a rational dimensional standard for use by certain sections the heat insulation industry. At the present time some seven manufacturers on thermal insulation have adopted the rationalized dimensional standard.

Another important problem concerns studies of vapor barriers applied to thermal insulation used especially in the air-conditioning and refrigeration fields where the group in charge has under consideration a draft of a test method. It is hoped that a tentative method will be completed at the next meeting of the committee.

Committee D-1 on Paint, Varnish, Lacquer, and Related Products

A.S.T.M. work in the field of paint, varnish, lacquer, and related products is concentrated in Committee D-1. At its extensive series of meetings in Pittsburgh there was consideration of work on accelerated tests, pigments, definitions, analytical methods, optical and physical properties, varnish, drying oils, etc.

The Subcommittee on Volatile Solvents for Inorganic Protective Coatings has under consideration a test for analysis of hydrocarbons which will be studied by means of a round-robin series of tests on determinations of available thinner and solvency. Consideration is being given to new specifications for heavy mineral thinner and it is expected they may be ready for action by the committee at its next meeting in June in Buffalo.

Committee D-1, through its Subcom-

mittee XIII on Shellac, is prepared to handle any international discussions on the grading and testing of shellac through the United Nations Standards Coordinating Committee. The personnel of the committee would, of course, include representatives from the various American organizations concerned with this subject.

The Subcommittee on Accelerated Tests for Protective Coatings has been especially active during the year. In addition to the session at Pittsburgh, four or five earlier meetings had been held during the past eight months. New sections are to be appointed on testing under humidity conditions and on alternate immersion and exposure conditions. Agreement was reached on revisions in the Tentative Method of Preparation of Steel Panels for Testing Paint (D 609). The Emergency Method of Test for Changes in Protective Properties of Organic Coatings on Steel Surfaces When Subjected to Immersion (ES-35) was approved by this subcommittee for submission to the Society for publication as tentative.

The Subcommittee on Pigments completed a new specification for pumice pigment for traffic and deck paint in response to requests by consumers. Under consideration are requirements for paste in oil, in the Tentative Specifications for Red and Brown Iron Oxide Pigments (D 84) and for Yellow Iron Oxide, Hydrated (D 768). Several of the present tentative specifications for pigments, particularly those for raw and burnt umber and raw and burnt sienna and venetian red, are to be recommended for adoption as standard.

The Subcommittee on Definitions recommended for adoption as standard the Tentative Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products (D 16) with revisions in the definition of the term "resin."

The Subcommittee on Methods of Analysis of Paint Materials completed revisions in the analytical procedures for zinc yellow pigment (D 444). This subcommittee is planning to undertake work on the chemical analysis of paints and new subgroups have been appointed to initiate these studies.

The Subcommittee on Optical Properties arranged plans for a rather extensive program which will be of long-range character and may involve research or investigative studies by various cooperative groups. The specific projects to be considered include the preparation of panels for gloss determination, color difference measurements, daylight reflectance, infrared reflectance, and preparation of panels for apparent luminous reflectance of traffic paint.

The subcommittee responsible for traffic paints recommended the adoption as standard of the Tentative Methods of Test for Light Sensitivity of Traffic Paint (D 712) and of Conducting Road Service Tests (D 713). The Method of Test for Dry to No-Pick-Up Time of Traffic Paint (D 711) will be revised and continued as tentative. The committee is continuing its study of accelerated tests. A test for light visibility is being studied and photographic pictorial standards for bleeding have been prepared and will be submitted for publication as tentative.

The Subcommittee on Physical Properties of Materials discussed a number of new projects on which work will be undertaken within the coming year. It is planned to enlarge the personnel and subjects to be studied will be assigned to small task groups. Progress was reported on the cooperative tests under way on four methods of determining film thickness which include the microscopic and microgage methods. Work is also being undertaken on tests for film hardness and an adhesion test is being studied.

The Subcommittee on Varnish is undertaking cooperative tests on alkyd resin solutions and varnishes. This includes a study of the rolling ball test. As a result of an extensive survey of methods for testing coating resins which included a large number of procedures being used in the industry, it was decided to organize a new subcommittee to undertake work on this subject. The various test procedures now covered in the Standard Methods of Testing Oleoresinous Varnishes (D 154) are being studied in detail and the committee expects to complete an extensive revision of these methods by 1947.

The Subcommittee on Cellulosic Coatings and Related Materials recommended the adoption as standard of the Tentative Method of Test for Water in Lacquer Solvents and Diluents (D 268) and also submitted a test for ester value of tricresyl phosphate as a tentative revision of the general test for lacquer solvents and diluents (D 268). New specifications for cellulose acetate completed during the year were submitted for publication.

The Subcommittee on Drying Oils recommended the adoption as standard of the Tentative Specifications for Oiticica Oil (D 601) with a change in the viscosity requirement from 18 poises to a value of 13 poises minimum. A number of minor revisions are also to be made in the Standard Methods of Testing Drying Oils (D 555).

At the conclusion of the regular business session a very interesting paper was presented by Dr. J. P. Kass, of the Interchemical Corporation Research Laboratories, on "The Analysis of Drying Oils by Ultraviolet Absorption Spectrophotometry."

Committee D-2 on Petroleum Products and Lubricants

(Meetings in Cleveland)

The meetings of Committee D-2 on Petroleum Products and Lubricants at the Hotel Cleveland, Cleveland, Ohio, March 17 through March 20 were extremely well attended, with many of the subcommittees being active and holding meetings.

The committee began the formation of three new technical committees. They will be H on Light Hydrocarbons, J on Aviation Fuels, and K on Cutting Oils. In the present process of formation, G. K. Brower of American Airlines is the temporary chairman of Technical Committee J, and O. L. Maag of Timken Roller Bearing Co. is the temporary chairman of Technical Committee K.

Technical Committee H is expected to complete its organization by the time of the June meeting, under W. G. Lovell, General Motors, Research Laboratories, as chairman and R. C. Alden, Phillips Petroleum Co. as secretary. The scope of this Technical Committee is outlined below:

Scope—Specifications, methods of testing and nomenclature of light hydrocarbons as defined below, except

(a) When used in the manufacture of paint, varnish, lacquer and related materials.

(b) When classifiable as industrial aromatic hydrocarbons used for the manufacture of chemicals or as solvents.

(c) When, with the addition of less than 2 per cent by volume of blending material, they are used as finished aviation fuel or motor fuel.

Definition: The term "light hydrocarbons" shall mean any hydrocarbons or mixtures of hydrocarbons which when subjected to appropriate procedures such as A.S.T.M. Method D 86 for the higher boiling materials, yield more than 90 per cent of recovered distillate below 329 F. (165 C.).

At the present time Subcommittees I on Pharmaceutical Tests and III on Paraffin Wax are working on methods of tests which will differentiate between the methods used for determining the oil content and melting point of petrolatum for pharmaceutical purposes and that used for industrial purposes. The former will result in a revision of A.S.T.M. Method D 721 to provide for tests at low temperatures requiring a new mercury-thallium thermometer graduated from -50 to $+70$ F. The latter is a new test for con-

gealing point of petroleum waxes which is based on Method 76/44 of the Institute of Petroleum.

Subcommittee V on Viscosity has expanded the method for Kinematic Viscosity (D 445) to cover determinations made at low temperature and also increasing the number of test points in the higher temperature range. The revised method will provide for tests below 32 F. and at temperatures of 68, 70, 77, 122, 140, and 180 F., in addition to the present three test points at 100, 130, and 210 F. A set of A.S.T.M. Kinematic viscosity thermometers will be developed for these new test temperatures.

The Method of Test for Acid and Base Numbers of Petroleum Products by Color-Indicator Titration (D 663) was revised and improved to cover the testing of new or used petroleum oils and lubricants. This test indicates changes that occur in an oil during use under oxidizing conditions, but is not intended to determine an absolute acidic or basic property that can be used to predict performance, such as bearing corrosion, under service conditions.

Subcommittee XI on the Determination of Inorganic Elements in Lubricants will publish for information, a number of new methods covering the determination of sulfur in oils containing additive agents, a new method for the determination of sulfated residue and a new method for phosphorus by acid oxidation procedure. The method for Carbon Residue (Conradson Carbon Residue) (D 189) will have a note added pointing out that the Ramsbottom Test (D 524) is to be preferred.

Subcommittee XXV on Analysis of Petroleum Products for Hydrocarbon Types continues extremely active. A proposed method for determination of aromatics in mixtures with naphthenes and paraffins by silica gel adsorption was completed and approved for publication as information.

This subcommittee also recommended as tentative a new procedure for determination of purity by freezing point. It is now completing another method for determining cryoscopic constants for the calculation of purity from freezing point. This latter method will specifically designate the compounds for which the test is recommended and the precautions necessary in specific cases. An important accomplishment was the revision of Emergency Method ES 45a which will be recommended for publication as tentative under the title "Method of Test for Olefins and Aromatics in Petroleum Distillants." The revised method includes within its scope the jet propulsion fuels. A test for density of hydrocarbon liquids by the pycnometer is being studied. Further work is in progress on the nitrogen tetroxide method for olefins. Method D 481–39 covering the determination of acid heat of gasoline has been placed under the jurisdiction of Subcommittee XXV in the hope that it may shortly be withdrawn due to the development of the improved methods by this subcommittee.

Technical Committee A has modified the test methods for Knock Characteristics of Motor Fuels (D 357) and for Aviation Fuels (D 614) to permit the use of the new shoulder suspended bouncing pin and covering improvements in the exhaust system specifications. A new tentative method for oxygen-bomb stability of gasoline by the potential gum method was submitted. Revisions were also made in the companion methods of test for existent gum in gasoline by air-jet evaporation, and for oxidation stability of gasoline by the induction period method. The sections on tetraethyl lead determination are also actively working to improve method D 526. The Section on Gasoline Specifications is also becoming active again so that the Specifications for Gasoline (D 439) can be brought into line with current practice.

Technical Committee B on Lubricating Oils submitted for publication as information a Proposed Method of Test for Determination of Foaming Characteristics of Viscous Petroleum Oils which is applicable to lubricating, hydraulic, and other viscous oils. The method involves measuring the volume and stability of foam produced when air is blown through a diffuser stone into oil at room and elevated temperature.

June Meeting; Buffalo:

At the Annual Meeting of the Society to be held in Buffalo, N. Y., June 24 to 28, Technical Committee B on Lubricating Oils of Committee D-2 on Petroleum Products and Lubricants will sponsor a Symposium on Oil Procurement Practices. At present five consumers are scheduled to describe their methods of procuring lubricating oils, and it is planned to have oil company representatives discuss the procurement practices from their viewpoint. These Symposiums, sponsored by Technical Committee B, have been a feature of the annual meeting for a number of years and have been received with great interest.

Based on a study made by a special committee under the Chairmanship of T. C. Smith, Committee D-2 has organized a new Coordinating Committee on Recommended Practices, under the Chairmanship of Mr. H. C. Mougey, which will study the entire subject.

At the Annual Meeting exhibits of grease testing equipment will be sponsored by Technical Committee G on Lubricating Grease. A number of new pieces of equipment now being tested by the committee will be shown, as well as equipment already standardized by the Society.

In June, Committee D-2 will again hold its annual dinner at which time the guest of honor will be Dr. H. C. Dickinson of the Bureau of Standards, a long-time member of Committee D-2.

Committee D-3 on Gaseous Fuels

The Subcommittee on Collection of Gaseous Samples reported that a draft of proposed methods of sampling liquid petroleum gases had been reviewed and was being further revised. This group also has in progress the preparation of separate methods covering sampling of manufactured gas and natural gas. It also plans to prepare a list of nomenclature and definitions of terms in general use.

The Subcommittee on Measurement of Gaseous Samples has plans under way for the preparation of a report on the use of small laboratory meters used in calorimetric work. It is expected that a draft of this report will be available by the time of the next meeting of Committee D-3 to be held in the Fall of 1946.

The determination of the calorific value of gaseous fuels has been one of the most important problems studied by the committee. A considerable amount of time was devoted to this subject for the past several years by the subcommittee responsible for this project. This work has now resulted in the development of a new tentative method of test for calorific value of gaseous fuels by the water flow calorimeter. The method provides detailed description of the apparatus and instructions for determining the total and net calorific values of fuel gases as purchased and sold. The method is restricted to gaseous fuels having total calorific values in the range from 300 to 3000 Btu. per standard cubic foot.

The Subcommittee on Determination of Specific Gravity and Density of Gaseous Fuels discussed the studies that had been made at the National Bureau of Standards on eleven instruments for the determination, indication, or recording of the specific gravity of gases. An abstract of the original report appeared in the American Gas Association's Monthly, June, 1944. It is now expected that the complete report will be published by the Bureau of Standards. At its meeting the committee

discussed the advisability of undertaking further work at this time. A definition of specific gravity has been completed and will be referred to members of the committee for study. It was also decided to set up a tolerance for specific gravity determinations, the exact values to be determined based on the report of the Bureau. The tolerances to be established will be such that they would be within the ability of the instruments tested, which were generally found to be satisfactory.

The Subcommittee on Determination of Water Vapor Content of Gaseous Fuels reported that it is studying a method which employs a chemical film such as phosphoric acid so placed as to cause two elements of an electrode to change the film's electrical conductivity with changes in moisture content of the gas surrounding the electrode. This method has been found of use in determining the water vapor in oxygen used by the Army Air Forces.

The subcommittee responsible for the study of complete analysis of chemical composition of gaseous fuels reported that a paper covering the results of the cooperative analysis of the first sample studied will be published by the National Bureau of Standards in a forthcoming issue of the *Journal of Research*. A report of the results obtained on the second sample is being made ready for distribution to the subcommittee.

The reproducibility of the most important new instrument for gas analysis, namely, the mass spectrometer, will be investigated by means of A.S.T.M. standard samples. This program was initiated before the close of the War by cooperation with the Rubber Reserves' cross-check program. Approximately 30 laboratories equipped with different types of mass spectrometers were recruited for these cooperative analyses. The Bureau is preparing samples for analysis by the mass spectrometer and these results will be cross-checked by means of the conventional chemical analysis methods. It is expected that this program will require from one to two years for completion.

Committee D-4 on Road and Paving Materials

At the well-attended meetings of Committee D-4 on Road and Paving Materials during A.S.T.M. Committee Week in Pittsburgh, which included sessions of six of the subcommittees, decisions were made on undertaking work on a number of new projects. These had to do with the determination of asphalt content, of emulsified asphalts, the resistance to the separation of asphalt from aggregate due to the presence of moisture, and structural properties of mineral aggregates.

It was decided to submit to letter ballot vote for publication as tentative a test for sulfonation index of road tars which will be identical in substance with the A.A.S.H.O. Standard Method T 108-44.

Decision was also reached on revisions in the Specifications for Calcium Chloride (D 98) and changes in the Methods of Chemical Analysis of Calcium Chloride (D 345).

The Tentative Methods of Sampling Bituminous Materials (D 140 – 41 T) were recommended for adoption as standard with certain revisions, this action being made jointly by Committee D-4 and Committee D-8 on Bituminous Waterproofing and Roofing Materials.

Revisions are also to be made in the Standard Method of Test for Amount of Material Finer Than 200 Sieve in Aggregate (C 117 – 37) and in the Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates (C 136 – 39). These changes were prepared jointly by Committee D-4 and Committee C-9 on Concrete and Concrete Aggregates.

The committee decided to recommend for adoption as standard the Tentative Specifications for Cut-Back Asphalt (Rapid Curing Type) (D 597 – 40 T) and for Cut-Back Asphalt (Medium Curing Type) (D 598 – 40 T). The definition of asphalt cement appearing in the Standard Definitions of Terms Relating to Materials for Roads and Pavement (D 8 – 33) is also to be revised. The present Tentative Method of Test for Abrasion of Gravel by Use of the Deval Machine (D 289 – 42 T) will be recommended for adoption as standard with several changes, one of which is a modification of the title and scope to indicate that the method covers the abrasion of graded coarse aggregate.

Committee D-5 on Coal and Coke

(Meeting in Chicago)

Interesting discussions on the work of A.S.T.M. Committee D-5 on Coal and Coke were held during the Committee's meeting in Chicago on February 26. Subjects covered included coal sampling, plasticity and swelling of coal and coke, ignitibility of coal and coke and coal classification. The Tentative Methods of Sampling Coals Classed According to Ash Content (D 492) are to be reviewed with the intention that at the A.S.T.M. Annual Meeting they would be recommended for adoption as standard and concurrently the existing methods of sampling (D 21) would be withdrawn. There has been much discussion and thought in the committee, on sampling of coal for volatile matter determination with respect to city smoke ordinances. A method has been drafted and together with a résumé of data on which the proposals were based will be published in the ASTM Bulletin in the coming year. Whether to adopt the present Tentative Test for Free-Swelling Index of Coal (D 720) will be decided by a letter ballot. Likewise a decision will be asked on the proposal to set up as a tentative the procedure of determining plastic properties using the Gieseler Type Plastometer.

Since studies on methods of determining ignitibility are still under way, a method of procedure published in the October, 1941 Bulletin is not to be recommended as tentative yet. It was stated at the meeting that an earlier assumption that the reaction is of first order with respect to oxygen pressure is incorrect and that more research work needs to be done with the method.

The Subcommittee on Coal Classification has advised that an equilibration method intended for determining the bed moisture of the lower rank coals had not correlated too well with samples taken from mines in the Illinois Survey work. One of the objectives of this group is to arrive at a simple method for determining types of coal. Dr. Rose, the Chairman of the Section, reviewed Dr. Syler's method in which he measures the reflectance of the petrological components of coal, claiming that the reflectance of the petrological components varies stepwise and does not change continuously with changes in rank of coal. Arrangements have been made whereby the Illinois Geological Survey would try out Dr. Syler's scheme by employing a recording spectrograph instrument which would remove the human element—these tests should show whether more work was justified.

Committee D-8 on Bituminous Waterproofing and Roofing Materials

Probably the most important matter reported at the meetings of Committee D-8 concerned a new project undertaken during the year on a study of stain properties of bituminous materials. The subcommittee responsible for this project has outlined cooperative test work that will be required to arrive at standard test methods. The results of the discussions lead to three general conclusions, namely:

1. The problem of staining by asphalts related to the manufacture of roofing and of asphalt laminated and coated papers has through experience been shown to correlate well with results of tests based on the staining of paper by asphalts. The test advanced in 1937 by Schweyer-Howell is widely used and can serve as a starting point for the committee to standardize a test for this type of staining. The test primarily measures the exudation of oily constituents by asphalts.

2. The problem of staining of paint coatings by asphalt-saturated felt in the manufacture of floor covering differs from the roofing and laminated paper problems and a separate test to measure proper characteristics of the asphalts in this respect is badly needed. Test methods specific to this problem should be studied. The thought was expressed that this problem was similar to one of painting lines on asphalt roads and painting over asphalt constructed roofs and coated steel structures.

3. Coal-tar products are not normally used where their staining characteristics are important. However coal-tar pitches should be examined after suitable tests are agreed on for bituminous products.

Based on the above three conclusions, the following two programs have been outlined for study:

(a) Cooperative study and investigations required in order to standardize a Stain Test based on the Schweyer-Howell Test.

(b) The selection and study of asphalts and test methods connected with the problem of staining of paint coatings by asphalts used in the construction of floor covering.

Suitable asphalts for use in the study of test methods for the staining of paint are being selected.

The Subcommittee on Nomenclature and Definitions submitted a revision in the definition of asphalt cements in which the penetration at 25 C. (77 F.) now specified as between "5 and 250" will be changed to read "5 and 300" under a load of 100 g. applied for 5 seconds.

The Subcommittee on Prepared Roofings and Shingles reported action to discontinue the emergency alternate provisions applying to its Specifications for Asphalt Roofing Surfaced with Powdered Talc or Mica (D 224) and also to the Specifications for Asphalt Roofing Surfaced with Coarse Mineral Granules (D 249). Certain of the emergency provisions that have been found satisfactory will be incorporated in the revised specifications.

The Subcommittee on Membrane, Waterproofing and Built-Up Roofing reported that it was continuing without change the Tentative Specifications for Asphalt-Saturated Asbestos Felts for Use in Waterproofing and in Constructing Built-Up Roofs (D 250) and Asphalt-Saturated and Coated Asbestos Felts for Use in Constructing Built-Up Roofs (D 655). There are several points on which these specifications differ from similar specifications now being considered by the Federal Specification Board. Until agreement can be reached, it was decided to continue the A.S.T.M. specifications as tentative for another year.

The subcommittee also reported revisions in the softening point and ductility requirements in the Tentative Specifications for Asphalt for Dampproofing and Waterproofing (D 449), for Coal-Tar Pitch for Steep Built-Up Roofs (D 654), and for Asphalt for Use in Constructing Built-Up Roof Coverings (D 312).

The Subcommittee on Tests for Mineral Surfacing Materials reported that it has under consideration requirements for three types of gradings of granules for roof coverings.

Committee D-9 on Electrical Insulating Materials

(Meeting in Atlantic City, N. J.

At the well-attended meetings of Committee D-9 in Atlantic City on March 7 and 8 the Subcommittee on Insulating Fabrics reported a number of changes in the Tentative Specifications for Flexible Treated Cotton and Rayon Sleeving (D 372). Certain of these revisions resulted from comments received from the Varnish Tubing Association. Work is being undertaken on a study of adhesive tape.

In the work on insulating papers there was completed a new method for determining the pH value of insulating paper. This method was prepared in cooperation with Committee D-6 on Paper and Paper Products. A revision will also be made in the test for air resistance of paper used in electrical insulation.

The Standard Methods of Testing Varnishes Used for Electrical Insulation (D 115) have been very thoroughly reviewed and as a result, a number of changes and improved descriptions of the tests will be made this year. Studies are under way on a test for drying time. The procedure for determining nonvolatile matter in varnishes will be studied in cooperation with Committee D-20 on Plastics. Consideration is also being given to undertaking work on silicones.

The Subcommittee on Molding Materials submitted new tentative methods of testing nonrigid polyvinyl tubing. Revisions were also recommended in the Tentative Specifications for Laminated Thermosetting Materials (D 709) affecting certain of the specification requirements and the tables of dimensional values. Consideration is being given to the development of specifications for polyvinyl tubing. The subcommittee is also studying power factor tests at low and high temperatures and procedures for determining insulation resistance.

The Subcommittee on Liquid Insulation has been especially active and a number of recommendations are to be included in the annual report of the committee this year, including a revision of the Standard Methods of Testing Electrical Insulating Oils (D 117) which methods will be established as a general reference standard covering the various tests to be made in evaluating insulating oils. The various new and revised methods will be published as separate tentatives under their own A.S.T.M. serial designation. These include a new test for dielectric strength of insulating oils of petroleum origin, a new method for sampling electrical insulating oils, and a new test for power factor. New sections were appointed to study problems dealing with interfacial tension and the determination of inorganic salts. A new section has also been established to consider the preparation of specifications for electrical insulating oils which specifications might take the form of screening specifications to be used for selecting a limited number of products which may be suitable for each class of required service and of recommended practices to be followed in the purchase of such oils. The subject of water in insulating oil has been studied by this committee for some time and a paper on this subject is expected to be presented to the Society at the Annual Meeting in Buffalo in June. A further report or paper covering the use of the Fisher method for determination of water as modified for use in testing insulating oils is also in preparation.

The Subcommittee on Ceramic Products plans to combine and revise certain of its methods of test and specifications for lime-glass insulators. The changes will result in a more logical and improved method of presentation. Five new sections are being set up to study the following types of ceramic insulation:

- Section A—Porcelain, Stoneware and Similar Vitreous Ceramic Products
- Section B—Glass and Glass Insulators
- Section C—Steatite and Related Low Loss Ceramic Bodies (will also include zircon, cordorite bodies)

Section D—Ceramic Dielectric Materials for Capacitors
Section E—Glass Bonded Mica

The Subcommittee on Mica recommended the adoption of the Tentative Method of Test for Power Factor and Dielectric Constant of Natural Mica (D 351). Further changes will be made in the general methods of testing mica which will include a provision for the rapid measurement of Q value as well as the bridge method now specified. The use of the dial gage micrometer for determining thickness will also be provided. Some changes will also be made in the table for judging the classification of quality of mica. A technical paper is in preparation covering the extensive work done during the war by various cooperators in connection with the development of the Tentative Specifications for Natural Block Mica and Mica Films Suitable for Use in Fixed Mica-Dielectric Capacitors (D 748).

Considerable attention has been given by the committee to the preparation of statements covering the significance of various tests prepared by the committee for testing electrical insulating materials. Statements have been completed covering the tests for dielectric strength, power factor, and dielectric constant.

The Subcommittee on Electrical Tests prepared revisions of its definitions for resistivity and resistance and also announced that an intensive study will be made of methods of determining insulation resistance under various conditions. As a result of developments during the war, the committee also plans to study tests at ultra high frequencies.

Committee D-11 on Rubber and Rubber-like Materials

There is intensive interest in the work of Committee D-11 as evidenced by the large attendance at the Pittsburgh meetings which included seventeen subcommittee sessions. At these meetings two new subcommittees were organized, one to deal with plasticity tests and the other on tests of resilience.

The new Subcommittee on Plasticity Tests will study means and methods for the processibility of rubber and rubber-like materials. This work will include studies of types of instruments now used in the industry and a collection of data on other instruments used on uncured stocks.

The new Subcommittee on Resilience Tests will develop definitions, specifications, and methods on resilience, hysteresis, and dynamic stiffness of rubber and rubber-like materials. Consideration will be given to determining the energy output expressed in terms of percentage energy input. The subcommittee plans to develop definitions for such terms as dynamic stiffness and dynamic modulus. It was decided to appoint sections to study such problems as rebound, free vibration, and forced vibration.

The Subcommittee on Insulating Tape recommended the withdrawal of the emergency alternate provisions applied to the Specifications for Friction Tape for General Use for Electrical Purposes (D 69) and for Rubber Insulating Tape (D 119). Both of these standards will be reverted to the tentative status and revised to include a number of the former emergency provisions. The Subcommittee on Insulated Wire and Cable reported that consideration is being given to new specifications for thermoplastic jackets used on electrical insulated cords and cables. It also recommended a revision and clarification of the ozone test in the Methods of Testing Rubber Insulated Wire and Cable (D 470). This subcommittee is responsible for certain emergency alternate provisions applying to several of its specifications for insulated wire and cable. It was decided at the meeting to appoint a steering committee to review these emergency provisions and to study and coordinate the various A.S.T.M. specifications for rubber insulation for wire and cable.

The Subcommittee on Abrasion Tests for Rubber Products presented a revision in the general procedure for Abrasion Resistance of Rubber Compounds (D 394) providing for a change in the speed of rotation of the drum in the National Bureau of Standards Abrader specified in Method B from a value of "40 r.p.m." to "45 ± 5 r.p.m." Consideration is being given to removal of Method C which uses the U. S. Rubber Co. Abrader from the present standard methods (D 394).

The subject of life tests of rubber products has received considerable attention in the committee. Further test work is to be undertaken on the following subjects: (1) a study of aging of polyvinyl chloride, in cooperation with Committee D-20 on Plastics, (2) a study of air oven testing methods, and (3) a study of the aging data that are now available on GR-S compounds. The latter two projects are expected to result in revisions and improvements of the present test methods.

The subcommittee responsible for hardness tests has decided to prepare a method covering the use of the Rex gage. This group also recommended the adoption as standard of the Tentative Test for Compression-Deflection Characteristics of Vulcanized Rubber (D 575) and also reported that considerable work is in progress studying the Test for Compression Set of Vulcanized Rubber (D 395) which when completed will result in a general modification of this test.

Tests for properties of rubber and rubber-like materials resulting from prolonged contact or immersion in liquids have also received considerable attention during the year. Important changes in the petroleum-base reference oils Nos. 1 and 3 used in Methods of Test for Changes in Properties of Rubber and Rubber-like Materials in Liquids (D 471) were recently incorporated in the revised method. This subcommittee is now studying the effect of the chemical structure of hydrocarbon immersion media on the swelling of rubber. A series of tests on this subject is under way.

The Subcommittee on Adhesion Tests reported that revisions in the Method of Test for Adhesion of Vulcanized Rubber (D 413 – 39) and the Method of Test for Adhesion of Vulcanized Rubber to Metal (D 429 – 39) are being given consideration. This group is also studying adhesion terminology in an endeavor to find a better way of expressing the nomenclature used in adhesion work.

The Subcommittee on Tests of Liquid Rubber Products has under way an active program on a study of the shear-type adhesion tests on various classes of adhesives. A round-robin series of tests is to be run to study various combinations, such as rubber to rubber, fabric to fabric, and metal to metal types of test specimens. Revisions were presented in the Tentative Methods of Testing Rubber Adhesives (D 816).

The Subcommittee on Low Temperature Tests has been making a study of various types of cold boxes used in various laboratories. As a result it is planned to include additional information in the Tentative Recommended Practice for Conditioning for Low-Temperature Testing (D 832). This will cover such features as adequate controls, methods of maintaining uniform temperatures over the cold boxes, and directions for making the boxes. The Tentative Test for Low-Temperature Brittleness of Plastics and Elastomers (D 746) and the Test for Young's Modulus in Flexure of Natural and Synthetic Elastomers at Normal and Subnormal Temperatures (D 797) were recommended for adoption as standard.

At the meeting of Subcommittee XI on Chemical Analysis there was presented a report of Dr. H. P. Burchfield's recent paper on Qualitative Tests for Rubber Polymers. A summary of

the report follows:

"The methods of detection of elastomers proposed by Dr. Burchfield have been evaluated for accuracy, speed and ease of manipulation using individual elastomer stocks and mixtures. The more rapid spot tests are satisfactory for the detection of individual elastomers, but are useful for mixtures only in a limited number of cases. The slower pyrolysis tests are equally good for the detection of individual elastomers, and somewhat more useful than spot tests on certain mixtures. In general, natural rubber-GR-S mixtures are difficult to identify as such, since the tests display the characteristics of the major component. The methods have possibilities for use in sorting scrap rubber."

As a result of this report, it was agreed that the section would carry on cooperative work to obtain data based on Dr. Burchfield's paper. This section would then revise the tentative methods of identification and qualitative analysis of synthetic elastomers.

Work has been started in the section dealing with the determination of sulfur and although about one year will be required to complete the program it is hoped to report progress at the June Meeting in Buffalo.

Technical Committee A on Automotive Rubber, which functions under the joint auspices of the S.A.E. and A.S.T.M., has been very active during the past year and meetings have been held at intervals of every two or three months. The technical committee reported the completion of four new specifications for hose which provide purchase requirements for the following types: (1) fuel and oil hose, metal lined, coupled, (2) fuel and oil hose, coupled or uncoupled, synthetic rubber tube and cover, (3) fuel and oil hose, braided reinforced, lacquer or cement covered, coupled or uncoupled, and (4) fuel and oil hose, synthetic rubber, wire reinforced circular woven type, lacquer cover.

It was also announced that Technical Committee A had received from the Bureau of Ordnance, U. S. Navy Department, the Distinguished Service Award for meritorious service to the Navy on problems dealing with rubber and rubber-like materials.

Committee D-13 on Textile Materials

(Meeting in New York City)

Committee D-13 on Textile Materials and 20 of its subcommittees and sections held a very active and well-attended series of meetings in New York at the Park Central Hotel on March 13 to 15. This is the first meeting that the committee had been able to hold since October, 1944, due mainly to hotel and travel restrictions resulting from the war. There was an attendance of 222 members and guests. At a dinner meeting held on Thursday evening, March 14, appropriate tribute was paid to Alexis Sommaripa, a former member of Committee D-13, who lost his life during the war while serving his country as a member of the Third Army.

The Subcommittee on Cotton and Its Products, through its Section on Cotton Yarns, took action on several important revisions in the General Methods of Testing and Tolerances for Cotton Yarns (D 180) which involve changes in the definitions dealing with commercial regain and yarn number and also modifications in certain details of the test procedures. At the meeting of the Section on Tire Fabrics, Dr. G. D. Mallory, Goodyear Tire and Rubber Co., presented two papers, one describing an apparatus for the gage testing of tire cord and the other a method of test including the apparatus for measuring the degree of adhesion of rubber to tire cord. This latter subject is of considerable interest to the tire cord industry. The committee also discussed revisions in the present methods for testing cotton tire cord. The details of the method will be given further study by the committee during the year. The Section on Narrow Fabrics considered the standardization of woven cotton tapes used in the electrical industry.

The Subcommittee on Rayon decided to recommend a number of changes in the Methods of Testing and Tolerances for Continuous Filament Rayon Yarns (D 258). This group will in the future be responsible for all synthetic and man-made fibers. The committee also plans to review periodically its field of activity in view of the current development of various synthetic fibers.

The Subcommittee on Wool has been exceptionally active and meetings of its several sections were held. Consideration was given to shrinkage determination of domestic wools, hardness testing of felt, and a flame test for felt. The group on pile floor covering discussed specifications for kraft cord yarns used in floor coverings and also the evaluation of intangible factors of luxury in floor covering and the evaluation of wear tests. The durability of washable wools to home and commercial laundering methods was discussed in detail. The committee plans to study several methods now in use. This group also received a report on a statistical study of the number of tests to be made on a fabric to obtain the strength of the fabric. This report will be studied by the committee during the year and will serve as a basis for specifying the number of tests for wool and part wool fabrics. The question of terminology and clarification of a woolen and worsted fabric will be studied looking toward the clarification of present-day nomenclature.

The Subcommittee on Asbestos reported on the consideration being given to the development of standards for asbestos cloth and to test procedures for the evaluation of asbestos textiles used for insulation purposes.

A series of interlaboratory tests on two methods of extracting bast and leaf fibers is being undertaken and tests will be made in twelve cooperating laboratories.

A very interesting discussion was held at a meeting of the Subcommittee on Household and Garment Fabrics regarding the initiation of work on the preparation of standards for ultimate consumer goods in view of the increasing demand for specifications and tests in this field. It was decided to appoint a steering committee to study the field of interest of Committee D-13 in the ultimate consumer goods program.

One of the most interesting sessions was a meeting of the Section on Abrasion Tests. This section is collecting data on abrasion and wear tests. This work will cover available data on (1) basic research, (2) comparative testing of fabrics on an abrasion machine, (3) correlation of wear tests with actual service tests. The subject of wear as studied by this committee includes a number of components, such as abrasion, crocking, perspiration, laundering, and chemical changes. While the committee considers that it may not be possible to standardize on any particular wear testing machine at this time, it is exploring the field to obtain complete information as a basis for future work on this subject.

The Subcommittee on Glass Fiber and Its Products is studying the effect of tension in winding on the measurement of the weight of glass yarn, also the effect of different types of clamping jaws upon the tensile strength values of yarn. Consideration is also being given to methods of tests for compatibility of fiber glass yarn and varnish, and to procedures for determining sizing.

The Subcommittee on General Testing Methods is studying a number of new tests including (1) evaluation of properties related to the hand of soft woven fabrics, (2) yarn numbers in woven fabrics, (3) accelerated aging, (4) soiling properties of textiles, (5) resilience of raw fabrics, (6) basic fiber properties, and (7) methods of distinguishing viscose and saponified rayons. The section responsible for testing machines reported on the measurement of the effect of gage length in the tension testing of textiles and on a

study of specifications for jaws and clamps.

The Section on Atmospheric Conditions is making a study of various drying ovens preparatory to drawing up a set of specific requirements.

The Subcommittee on Nomenclature and Definitions approved revisions in a number of the present textile terms and completed new definitions and additional terms including tenacity, density, textile fabric, felt, wool, plush, velvet, and yarn number. The committee recommended the continuation as tentative of the Recommended Practice for a Universal System of Yarn Numbering (D 861 – 45 T) which is based on the Grex System of designating yarn made from any type of fiber.

Committee D-19 on Water for Industrial Uses

Committee D-19 met in Pittsburgh on February 19 and 20 (prior to committee week) and most of its subcommittees also convened.

One of the most important subjects discussed was the Proposed Method of Test for Dissolved Oxygen which was published in the 1945 Annual Report of the committee for information and also published in the December 1945 BULLETIN. These methods were reviewed in their entirety, bringing to the attention of the members present all communications received by the committee. The subject matter as previously published was retained. Editorial changes referring to the apparatus were approved. It was the action that after securing another letter ballot vote from the technical committee, the methods be submitted with recommendations to the Administrative Committee on Standards, for acceptance as tentative.

Another subject discussed was a Proposed Recommended Practice for Corrosion Testing based on the N.D.H.A. Tester. A proposed draft will be circulated to the members of the committee for further comment before being submitted to the Society. It is hoped to complete this work by the next meeting of the committee in June.

A Proposed Recommended Practice on the Field Sampling of Water-formed Deposits is being recommended for publication as tentative.

Minor changes were made in a number of other specifications and methods under the jurisdiction of the committee and a set of definitions is being developed under the general subject of water-formed deposits. These definitions will include scale, sludge, corrosion products and biological deposits.

The proposed Symposium on the Identification of Water-formed Deposits will be postponed until 1947 as it was found impossible to complete the program in time for the Annual Meeting this year.

Committee D-20 on Plastics

(Meeting in Atlantic City, N. J.)

Committee D-20 and a number of its subcommittees held well-attended meetings in Atlantic City on March 6 and 7. Subcommittee I on Strength Properties decided to appoint a new section to study tests for bonding strength. A revision of the test for tensile strength of thin sheets and plates was approved. The Tentative Recommended Practice for Long-Time Tension Tests (D 674) was recommended for formal adoption. A new Test for Determining the Degree of Blocking of Sheet Materials Under Standard Conditions of Temperature and Pressure will be submitted for publication as tentative. This method is intended for comparatively thin flexible materials which should show no blocking or only a slight degree of blocking during storage and use.

The Subcommittee on Thermal Properties outlined a program for determining the flow temperature of thermoplastics. A program is also under way on broadening the applicability of the test for heat distortion of plastics. It was also decided to make a further study of the flow test particularly to decrease the variations in the tests when made in different laboratories.

The Subcommittee on Optical Properties has prepared a new method for determination of line of sight deviation, which will be issued as tentative.

Action was taken to revise the various exposure cycles prescribed in the Test for Resistance of Plastics to Accelerated Service Conditions (D 756). This method includes seven procedures based upon various atmospheric influences encountered in the interior of buildings, interior of transport facilities such as motor vehicles, airplane cargo spaces, wiring interiors, holds of ships, and railroad cars. This method also covers the testing of finished parts on articles of commerce as well as test specimens. It was decided to undertake a study of accelerated weathering using a procedure based on the Tentative Recommended Practice for Operating Light and Water Exposure Apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products (D 822).

The Subcommittee on Specifications has completed revisions in the Specifications for Cellulose Acetate Plastic Sheets (D 786) to provide for flammability requirements. The Tentative Specifications for Ethyl Cellulose Molding Compounds (D 787) are being revised to include requirements for flow temperatures and for tensile strength. Several changes are also being made in the Tentative Specifications for Cellulose Acetate Molding Compounds (D 706) as regards the test procedures for tensile strength, impact and dielectric strength. Referred to letter ballot will be a proposal to delete the requirements for dielectric strength from the several specifications for thermoplastic molding compounds and from the several specifications for nonrigid materials.

A new Method for Determining the Apparent Density and Bulk Density of Molding Powders was submitted by the Subcommittee on Molds and Molding Processes for publication as tentative.

A revision of the Tentative Method for Conditioning Plastics and Electrical Insulating Materials for Testing (D 618) was completed under the joint cooperation of Committee D-20 and Committee D-9 on Electrical Insulating Materials. The revision will provide a standard procedure and three functional procedures, the latter comprising a dry, humidity, and immersion procedures.

There was considerable interest in the activity of the Subcommittee on Research. Under consideration are problems of flow characteristics and impact strength. The latter includes a study of size and shape relationship and the relationship of notch to the geometry of the present Izod impact specimen. Studies are being made of various methods of notching specimens. The following three interesting papers were presented at the meeting of this subcommittee:

A New Impact Evaluation—H. M. Quackenbos, Bakelite Corp., Bloomfield, N. J.

Some Visual Data on Impact Testing—H. K. Nason, Monsanto Chemical Co., Central Research Dept., Dayton, Ohio.

New Apparatus for Film Testing—C. H. Adams, Monsanto Chemical Co., Plastics Div., Springfield, Mass.

Committee D-20 has appointed a study committee on simulated service testing and also a study committee to consider what work might be done in the field of ultimate consumer goods.

The Subcommittee on Prosthetics appointed to cooperate with the authorities at Walter Reed and England General Hospitals has developed several suggestions some of which have been approved by the subcommittee and others are being studied.

Committee B-4 on Electrical-Resistance Alloys

(Meeting in New York)

Committee B-4 and its subcommittees met at the Hotel Woodstock in New York, February 20 to 22, with Chairman Dean Harvey presiding, and action was taken on many important projects on which the committee is currently working.

Among other actions taken was the approval of revised by-laws which establishes honorary members of the committee, a distinction which was unanimously voted for Dr. H. L. Curtis and Mr. Harvey. The latter was also elected Honorary Chairman of the committee to take effect when he retires this year after having served the committee as chairman since its organization in 1925.

Subcommittee V on Wrought and Cast Alloys for High-Temperature Use made a few minor editorial corrections in the tentative specifications for 35-15 alloy which will shortly be published and is working on specifications for alloy castings containing higher ranges of nickel and chromium.

Subcommittee VII on Thermostat Metals is proposing a revision of Tentative Method of Test for Equivalent Yield Stress of Thermostat Metals (B 191 - 44 T); is actively working on several other methods—one on the comparative performance of thermostat elements, another on the hardness of thermostatic metals—and is studying a comparison of the tensile *vs.* bending methods for the determination of the modulus of elasticity.

Subcommittee VIII on Metallic Materials for Radio Tubes and Incandescent Lamps continues active in constructive work, particularly in its section on Cathode Materials. This section has developed a new form for recording chemical analysis and has approved a tentative method of coating cathodes. It is also preparing several melts to study the effect of controlled magnesium and silicon additions. Excellent progress is being made in the correlation of the tests on diodes.

Other sections of this subcommittee are active; one is studying a proposed method of test for the permeability of feebly magnetic materials, methods for checking tensile stress and elongation of fine wire, and methods of test for glass-sealing alloys. It is also proposed to revise and combine the methods of Testing Nickel and Nickel-Alloy Wire and Ribbon for Electronic Tube Filaments (B 118) and the Methods of Test for Lateral Wire Grids of Electronic Devices (B 156).

Subcommittee IX on Methods of Test for Alloys in Controlled Atmospheres is studying various corrosion problems and methods of test related thereto. Cooperative tests are being arranged which will furnish the subcommittee data on which future action may be taken.

Members of Subcommittee X on Contact Materials report very good agreement between their laboratories in the use of the A.S.T.M. contact testing machine and the application of the Method for Life Test of Electrical Contact Materials (B 182) which was revised at the last meeting of the committee. This subcommittee also continues its work on the tentative method of tests for determining the hardness of contact materials.

Texts and Reference Books on Analytical Chemistry

AMONG a number of valuable reference books and texts widely used and referred to by the analytical chemist and those concerned with this field are three publications issued by the Macmillan Co., 60 Fifth Ave., New York, N. Y. Notes on these three books follow:

Quantitative Inorganic Analysis—I. M. Kolthoff and E. B. Sandell

While the "Textbook on Quantitative Analysis" by I. M. Kolthoff and E. B. Sandell has been written primarily as a textbook for students of analytical chemistry, its coverage of the subject is so complete and authoritative that it also constitutes a most valuable reference for the practicing chemist. The basic principles and detailed information on all types of analytical chemistry are capably presented. A number of references to this publication for additional information are made in A.S.T.M. chemical methods. For example in both the Recommended Practices for Apparatus and Reagents for Chemical Analysis of Metals (Tentative) E 50, and the new tentative Recommended Practice for Photometric Methods of Analysis of Metals E 60, this publication is listed as a valuable reference. This 800-page book contains some 130 figures and some 70 tables of useful information. The revised edition, which was published in 1943, was reprinted in 1945 and is available at $4.50 per copy from the Macmillan Co.

Characterization of Organic Compounds—McElvain

Of interest to the organic chemist is "The Characterization of Organic Compounds" by Samuel M. McElvain. This book covers a procedure for the characterization of organic compounds and includes a discussion of the means of determining and correlating the necessary properties of the compounds for this purpose. While written primarily as a textbook for advanced students of organic chemistry, the book should also be useful as a reference work. 280-page publication is available at $3.40.

Industrial Chemistry of Colloidal and Amorphous Materials—Lewis, Squires and Broughton

Another valuable reference book is "Industrial Chemistry of Colloidal and Amorphous Materials" by Warren K. Lewis, Lombard Squires, and Geoffrey Broughton. The book is a text on the industrial chemistry of colloidal and amorphous materials. It is intended to give the reader an insight into the phenomena underlying the methods of these industries, such that he can appreciate the potentialities and limitations of process and materials and develop his capacity for controlling and using them. This 540-page publication is available from Macmillan at $6.00.

Calendar of Society Meetings

(Arranged in Chronological Order)

AMERICAN CHEMICAL SOCIETY—109th Meeting, April 8–12, Atlantic City, N. J.

AMERICAN CONCRETE PIPE ASSOCIATION—38th Annual Meeting, April 11–12, Edgewater Beach Hotel, Chicago, Ill.

ELECTROCHEMICAL SOCIETY—Spring Congress, April 11–13, Birmingham, Ala.

AMERICAN SOCIETY OF CIVIL ENGINEERS—Spring Meeting, April 17–19, Bellevue-Stratford Hotel, Philadelphia, Pa.

TWENTY-NINTH ANNUAL OPEN-HEARTH STEEL AND BLAST FURNACE AND RAW MATERIALS CONFERENCES, April 25–26, Chicago, Ill.

AMERICAN CERAMIC SOCIETY—Forty-eighth Annual Meeting, April 28–May 1, Hotel Statler, Buffalo, N. Y.

AMERICAN FOUNDRYMEN'S ASSOCIATION—Fiftieth Annual Foundry Congress and Show, May 6–10, Public Auditorium, Cleveland, Ohio.

AMERICAN IRON AND STEEL INSTITUTE—Fifty-fourth General Meeting, May 23 Waldorf-Astoria Hotel, New York, N. Y

METAL POWDER ASSOCIATION—Annual Spring Meeting, June 13, Waldorf-Astoria Hotel, New York, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Semi-Annual Meeting, June 17–20, Detroit, Mich.; Fall Meeting, September 30–October 2, Boston, Mass.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION—Fifty-third Annual Meeting, June 20–23, Jefferson Hotel, St. Louis, Mo.

American Society for Testing Materials—Forty-ninth Annual Meeting and Exhibit of Testing Apparatus and Related Equipment, June 24–28, Hotel Statler, Buffalo, N. Y.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—June 24–28, Detroit, Mich.

NATIONAL INSTITUTE OF GOVERNMENTAL PURCHASING—Annual Conference and Products Exhibit, August 19–21, Hotel Stevens, Chicago, Ill.

AMERICAN PETROLEUM INSTITUTE—Annual Meeting, November 11–14, Stevens Hotel, Chicago, Ill.

New Members to March 14, 1946

The following 136 members were elected from January 18 to March 14, 1946, making the total membership 5868:

Names are arranged alphabetically—company members first, then individuals.

Chicago District

Dick Co., A. B., T. S. Chambers, Manager of Chemical Research and Engineering, 720 W. Jackson Blvd., Chicago 6, Ill.

Clemmitt, W. B., Chief Engineer, Freyn Engineering Co., 58 E. Washington St., Chicago 2, Ill.

Fridstein, Meyer, Partner, Fridstein Engineering Co., 228 N. La Salle St., Chicago 1, Ill.

Jones, Myron A., Metallurgical Engineer, The Youngstown Sheet and Tube Co., East Chicago, Ind.

Russell, John James, Research Chemist, Ekco Products Co., 1949 N. Cicero Ave., Chicago 39, Ill.

Cleveland District

Cleveland Wire Spring Co., E. A. Kerschen, Metallurgical Engineer, 1281 E. Thirty-eighth St., Cleveland 14, Ohio.

Caldwell Company, The, Robert H. Crossley, Technical Director, 2412 First Central Tower, Akron 8, Ohio.

Bartlett, K. M., Director of Research, Thompson Products, Inc., 2196 Clarkwood Rd., Cleveland 3, Ohio.

Chapman, T. M., Chief Metallurgist, Republic Steel Corp., 3100 E. Forty-fifth St., Cleveland 4, Ohio.

Doswell, Howard R., Vice-President and Secretary, The Permold Co., W. Liberty St., Medina, Ohio.

Forbrich, Louis R., Chemical Research Engineer, The Bessemer Limestone and Cement Co., 1100 City Bank Bldg., Youngstown, Ohio.

Koppe, James C., 336 Nineteenth St., N. W., Canton, Ohio.

Schaefer, Ralph A., Director of Research, Cleveland Graphite Bronze Co., 17000 St. Clair Ave., Cleveland 10, Ohio. For mail: 18028 Hiller Ave., Cleveland 19, Ohio.

Siefert, C. G., Manager, Die Casting Div., Cleveland Hardware and Forging Co., 4518 Lakeside Ave., Cleveland, Ohio.

Detroit District

Bigge, Donald M., Metallurgist, Chrysler Corp., Detroit, Mich. For mail: 807 N. Woodward, Birmingham, Mich.

Gault, Russell C., Chief Metallurgist, Chrysler Corp., Plymouth Division, Detroit, Mich. For mail: 15329 Granville, Detroit 23, Mich.

Heath, Roy E., Manager, Industrial Dept., Wyandotte Chemicals Corp., Wyandotte, Mich.

Jacobi, L. J., Inspection and Standards Engineer, The Detroit Edison Co., 2000 Second Ave., Detroit 26, Mich.

Lovell, Wheeler G., Chemist, Research Laboratories Division, General Motors Corp., Box 188, North End Station, Detroit 2, Mich.

Rowan, J. W., Chief Metallurgist, Warner Aircraft Corp., 20263 Hoover Ave., Detroit 5, Mich.

Thomas, Leon B., Foundry Manager, Wilson Foundry and Machine Co., Pontiac 11, Mich. For mail: 9 Utica Rd., Indian Village, Pontiac, Mich.

New York District

Fibre Products Laboratories, Oliver G. Edwards, Engineer, 51 Washington St., New Brunswick, N. J.

National Union Radio Corp., Otto G. Honzl, Engineer, 1181 McCarter Highway, Newark, N. J.

New York Laboratory Supply Co., Inc., M. Resnick, President, 78 Varick St., New York 13, N. Y.

Shaw Insulator Co., J. H. DuBois, Executive Engineer, 160 Coit St., Irvington 11, N. J.

Steel and Alloy Tank Co., Frank P. Krol, Chief Engineer, Foot of Bessemer St., Newark 1, N. J.

Tilo Roofing Co., Inc., R. J. Tobin, President, 347 Longbrook Ave., Stratford, Conn.

Bodell, Philip T., Executive Textile Research Engineer, Collins & Aikman Corp., 200 Madison Ave., New York 16, N. Y.

Boyd, Helen Harrington, Executive, Benton & Bowles, Inc., 444 Madison Ave., New York 22, N. Y.

Emery, A. H., III, Vice-President, The A. H. Emery Co., 682 Main St., Stamford, Conn.

Engstrand, E. Raymond, Metallurgist, Micro-Ferrocart Products Division, Maguire Industries, Inc., 375 Fairfield Ave., Stamford, Conn.

Hill, Edward A., Product Engineer, The Palnut Co., Inc., 61 Cordier St., Irvington, N. J.

Kendall, Donald S., Treasurer and General Manager, Mack Molding Co., Ryerson Ave., Wayne, N. J.

Levi, Solomon, Consulting Engineer, Modecraft Co., Inc., 300 Wyckoff Ave., Brooklyn 27, N. Y.

Mort, Linwood G., Engineer, Argraves & Mort, 70 College Ave., New Haven, Conn.

Quilty, Thomas P., Junior Civil Engineer of Design, Port of New York Authority, 111 Eighth Ave., New York, N. Y. For mail: 884 Riverside Dr., New York 32, N. Y.

Thurn, Russell E., Senior Chemical Engineer, Barber Asphalt Corp., Barber, N. J.

Zezza, Carlo F., Owner, Zezza Associates, 79 Wall St., New York 5, N. Y. For mail: 456 Esplanade, Pelham Manor 65, N. Y.

Zuhr, Henry, President, Henry Zuhr, Inc., 187 Lafayette St., New York 13, N. Y.

Northern California District

Isbell, Harvey G., Chief Chemist, Mare Island Naval Shipyard, Mare Island, Calif. For mail: 416 Hampshire St., Vallejo, Calif.

Prugh, George S., Assistant Manager, Pacific Coast, Bausch & Lomb Optical Co., 593 Market St., San Francisco 5, Calif.

Philadelphia District

Asbestos Cement Products Assn., Donald Tulloch, Jr., Manager, Seventeenth Floor, Inquirer Bldg., Philadelphia 30, Pa.

French and Co., Samuel H., Daniel C. Longstreth, President, 475–77 York Ave., Philadelphia 23, Pa.

Janney Cylinder Co., W. T. Janney, President, 7425 State Rd., Philadelphia 36, Pa.

Publicker Industries, Inc., Nathan Lacktman, Chief Control Chemist, Delaware Ave. and Bigler St., Philadelphia 48, Pa.

Keyser, P. V., Jr., Research Director, Research and Development Labs., Socony-Vacuum Laboratories, Paulsboro, N. J.

Larson, H. C., Assistant Metallurgical Engineer, Bethlehem Steel Co., Inc., Bethlehem, Pa.

Miller, Herman A., Manager, Argo Lamp Co., Philadelphia, Pa. For mail: 5828 Woodcrest Ave., Philadelphia 31, Pa.

Pearson, William A., Assistant Chief Metallurgist, Harrisburg Steel Corp., 2401 N. Front St., Harrisburg, Pa.

Philadelphia, City of, Bureau of Engineering, Surveys and Zoning, Department of Public Works, A. F. Burbidge, Engineer of Tests, 1101 City Hall Annex, Philadelphia 7, Pa.

Robison, Arch G., Research Fellow in Chemical Engineering, Division of Chemical Engineering, University of Delaware, Newark, Del. [J]*

Stillman, Jesse W., Analytical Division Head, E. I. du Pont de Nemours and Co., Inc., Experimental Station, Wilmington 98, Del.

Temple University, Sullivan Memorial Library, Philadelphia 22, Pa.

Wood, James, A. M. G. Aircraft, Navy Yard, Philadelphia, Pa. For mail: 2622 S. Seventy-sixth St., Philadelphia 42, Pa.

Pittsburgh District

Duraloy Co., The, Harvey T. Harrison, Vice-President, Scottdale, Pa.

Lewis Foundry and Machine Division of Blaw-Knox Co., F. E. Walling, Box 1586, Pittsburgh 30, Pa.

Albrecht, Kurt, Chemist, Calgon, Inc., 323 Fourth Ave., Pittsburgh 30, Pa.

Benford, F. G., Chief Metallurgist, West Leechburg Division, Allegheny Ludlum Steel Corp., West Leechburg, Pa.

Biggs, Richard A., Product Application Engineer, Pittsburgh-Corning Corp., 632 Duquesne Way, Pittsburgh 22, Pa.

Dunmire, H. J., Manager, Butler Refinery, Freedom-Valvoline Oil Co., Box 911, Butler, Pa.

Miller, Richard F., Development Engineer, Carnegie-Illinois Steel Corp., 714 Frick Bldg., Pittsburgh 30, Pa.

Pafenbach, A. Roy, Supervisor, Quality Control, Carnegie-Illinois Steel Corp., 403 Carnegie Bldg., 434 Fifth Ave., Pittsburgh 19, Pa.

Patrick, D. W., Plant Metallurgist and Chief Inspector, Jones & Laughlin Steel Corp., Electricweld Tube Div., 363 Seneca St., Oil City, Pa.

Schwartz, Morton, Electrochemist, Standard Steel Spring Co., Coraopolis, Pa. For mail: 467 Cypress Dr., Coraopolis, Pa. [J]

Shoffner, John R., Professional Engineer, Keystone Bldg., Kittanning, Pa.

Suckfield, G. A., Chief Engineer, Pressed Steel Car Co., Inc., 2500 Koppers Bldg., Pittsburgh 30, Pa.

St. Louis District

Heath, Robert L., Metallurgical Engineer, Climax Molybdenum Co., 1512 Ambassador Bldg., St. Louis 1, Mo.

Southern California District

Norris Stamping and Manufacturing Co., Fred M. Arnold, Metallurgist, Box 68, Station K, Los Angeles 11, Calif.

James, W. S., Specification Writer, United Rexall Drug Co., 355 S. Broadway, Los Angeles, Calif. For mail: 2077 Hillhurst Ave., Los Angeles 27, Calif.

Richardson, Harvey R., Supervisor, Standards, Materials Engineering and Specifications Section, R. & D. Dept., Naval Ordnance Test Station, Inyokern, Calif.

University of Redlands Library, Redlands, Calif.

Western New York-Ontario District

Cunningham, Geoffrey E., Head of Research Dept., Dollinger Corp., Rochester 3, N. Y. For mail: 103 Middlesex Rd., Rochester 10, N. Y.

Fair, J. L., Research Engineer, The W. C. Wood Co., Ltd., 123 Woolwich St., Guelph, Ont., Canada.

U. S. and Possessions

Edward Orton, Jr., Ceramic Foundation, The, John L. Carruthers, Manager, 1445 Summit St., Columbus 1, Ohio.

Electric Auto Lite Co., The, Lamp Division, W. B. Stephenson, Jr., Chief Chemist, 4900 Spring Grove Ave., Cincinnati 32, Ohio.

Hamilton Foundry and Machine Co., The, Peter E. Rentschler, President, 1551 Lincoln Ave., Hamilton, Ohio.

Homestake Mining Co., H. A. Walker, Assistant General Manager, Lead, S. Dak.

Langsenkamp Co., F. H., H. M. Oshry, Works Manager, 229 E. South St., Indianapolis, Ind.

Midwest Foundry Division of L. A. Darling Co., R. T. Archbold, Vice-President, Coldwater, Mich.

National Electric Coil Co., N. J. Greene, Chief Engineer, 794 Chambers Rd., Columbus 16, Ohio.

Oxychloride Cement Assn., Inc., C.

Huddleston Bear, Executive Secretary, 1010 Vermont Ave., N. W., Washington 5, D. C.

SOUTHERN RAILWAY SYSTEM, J. B. Akers, Chief Engineer, McPherson Square, N. W., Washington 13, D. C.

VICTOR ELECTRIC PRODUCTS, INC., O. Thomas Pfefferkorn, Laboratory Director, 2950 Robertson Ave., Cincinnati 9, Ohio.

WESTERN PETROLEUM REFINERS ASSN., John C. Day, Secretary, 1414 Hunt Bldg., Tulsa 3, Okla.

WIRE REINFORCEMENT INST., T. J. Kauer, Managing Director, 1049 National Press Bldg., Washington 4, D. C.

BARTLETT, VIRGIL C., Chemist, Ideal Cement Co., Denver, Colo. For mail: 913 W. Oak, Ft. Collins, Colo.

DAVIS, LEWIS, Davis & Bennett, Inc., 306 Main St., Worcester 8, Mass.

DIRECCI N GENERAL DE INDUSTRIA Y MATERIAL, Spanish Embassy, 2700 Fifteenth St., N. W., Washington 8, D. C.

DONALDSON, HARRY C., JR., Research Chemist, Cluett, Peabody and Co., Inc., 433 River St., Troy, N. Y.

DUNHAM, ROBERT E., President, Sunray Electric, Inc., Warren, Pa.

FANNING, WALTER L., Mill Technician, Dover Mill Co., Shelby, N. C.

FAUNCE, PAUL F., Process Engineer, Raytheon Manufacturing Co., 55 Chapel St., Newton 58, Mass.

FINK, FREDERICK W., Research Engineer, Battelle Memorial Inst., 505 King Ave., Columbus 1, Ohio. For mail: 1900 Devon Rd., Columbus 8, Ohio.

FREEMAN, J. G., Chemical Engineer, The Dayton Oil Co., Box 851, Dayton 1, Ohio.

FROLICH, A. K., Chief Engineer, Ash Grove Lime and Portland Cement Co., 1114 Fairfax Bldg., Kansas City 6, Mo.

GARDNER, PAUL N., Vice-President, Henry A. Gardner Laboratory, 4723 Elm St., Bethesda 14, Md.

GRAMSTORFF, EMIL A., Professor and Head, Department of Civil Engineering, Northeastern University, Boston, Mass.

HANNA, EDWARD C., Factory Manager, Rhode Island Tool Co., 148 W. River St., Providence 1, R. I.

HENDRICKSON, E. M., Chief Engineer, Paxton-Mitchell Co., 2614 Martha St., Omaha 5, Nebr.

HEWES, PAUL Q., University of Alabama, University, Ala. For mail: Box 2078, University, Ala. [J].

INSTITUTO NACIONAL DE TÉCNICA AERONAUTICA (MADRID, SPAIN), Spanish Embassy, Office of the Military Attaché, Washington 8, D. C.

JONES, PAUL GUY, Assistant Professor in Theoretical and Applied Mechanics, University of Illinois, Talbot Laboratory, Urbana, Ill.

KOSLIN, NATHAN L., Director, The Nalin Laboratories, 2641 Cleveland Ave., Columbus 3, Ohio.

LAVALLEY, PAUL E., Chemical Engineer, Sylvania Electric Products, Inc., Ipswich, Mass. For mail: 7 Currier Park, Ipswich, Mass. [J]

LEE, GEORGE HAMOR, Associate Professor of Mechanical Engineering, Postgraduate School, United States Naval Academy, Annapolis, Md.

MATTHEWS, FRED W., Research Chemist, Research and Development Lab., Canadian Industries, Ltd., McMasterville, P. Q., Canada.

MCKINNEY, JOEL, Chemical Engineer, Gulf Research and Development Co., Harmarville, Pa. For mail: R.F.D. 2, Franklin, Pa. [J]

MCLAIN, CECIL H., Consulting Chemical Engineer, 528-A, M & M Bldg., Houston 2, Tex.

MITCHELL, C. A., X-Ray Sales Dept., Westinghouse Electric Corp., 2915 Wilkens Ave., Baltimore 3, Md.

O'NEIL, FRANK J., Physicist, Pacific Mills, Worsted Div., Canal St., Lawrence, Mass.

PETERSON, PHILIP R., Manager, The C. M. Fassett Co., 19 W. Main St., Spokane 8, Wash.

READ, D. E., Works Manager, Sorel Steel Foundries, Ltd., Sorel, P. Q., Canada.

SIMONDS, HENRY G., Textile Consultant, Room 1011, 141 Milk St., Boston 9, Mass.

STANTON, FRANK, Architect, 209 Seneca St., Seattle 1, Wash.

URSO, P. J., Division Sales Manager, West Virginia Steel and Manufacturing Co., Box 118, Huntington 6, W. Va.

VAN WAGNEN, E. H., Senior Engineer, U. S. Forest Products Laboratory, Madison 5, Wis.

VAN WAZER, JOHN R., Physical Chemist, Research Lab. Rumford Chemical Works, Rumford, R. I.

WEBECK, RUSSELL C., Works Engineer, Walworth Co., Kewanee, Ill.

WUEST, REVEREND ALBERT A., Associate Professor, St. Joseph's College, Collegeville, Ind.

Other than U. S. Possessions

ALUMINUM LABORATORIES, LTD., H. H. Richardson, Vice-President, 1800 Sun Life Bldg., Montreal 2, P. Q., Canada.

BRITISH HARTFORD FAIRMONT SYNDICATE, LTD., THE, Thomas Wardley, Chief Engineer, Rockware Ave., Greenford, Middlesex, England.

ESSEX AERO, LTD., R. J. Cross, Managing Director, Queen St., Gravesend, Kent, England.

MONSANTO CHEMICALS, LTD., E. Mather, Production Superintendent, Ruabon, Wrexham, Denb., England.

NORGES STANDARDISERINGS-FORBUND, Kaare Heiberg, Director, Kongsensgate 15, Oslo, Norway.

STANDARD TELECOMMUNICATIONS LABORATORIES, N. B. Noble, Administrative Manager, Connaught House 63, Aldwych, London, England.

MAYNE, JOHN EDWIN OAKLEY, Director, Vinyl Products, Ltd., Butter Hill, Carshalton, Surrey, England.

PEREZ GUERRA, GUSTAVO, Civil Engineer, Parsons, Brinckerhoff, Hogan & Macdonald, Consulting Engineers, C. A., Apartado 168, Caracas, Venezuela.

PHILIPSON, GORAN, Chemical Engineer, Centralbolaget for Kemiska Industrier, Sveavagen 48, Stockholm, Sweden.

SOCIEDAD COLOMBIANA DE INGENIEROS, Apartado 291, Bogota, Colombia.

SVENZON, THOR, Superintendent Engineer, Almedahl-Dalsjöfors A. B., Dalsjöfors, Sweden.

SWEDENBORG, HAKAN, Managing Director, Tekniska Röntgencentralen A. B., Drottning Kristinas väg. 36, Stockholm, Sweden. For mail: Vintervägen 36, Stocksund, Sweden.

TIGERSCHIOLD, MAGNUS, Technical Director, Jernkontoret, Kungsträdgårdsgatan 6, Stockholm, Sweden.

UNIVERSIDAD DE SAN CARLOS, FACULTAD DE INGENIERIA, Juan Francisco Urruela N., Librarian, 8a Ave. Sur No. 16, Guatemala, Guatemala.

YACIMIENTO PETROLIFERO FISCAL DE PLAZA HUINCUL, Neuquen, F. C. S. Argentina.

YACIMIENTO PETROLIFERO FISCAL DE COMODORO RIVADAVIA, Chubut, Argentina.

YACIMIENTOS PETROLIFEROS FISCALES, Destileria Fiscal La Plata, Estacion Dock Central, F. C. S., Argentina.

* [J]—Denotes Junior Member.

Testing Brochure

RECENTLY issued by the Pittsburgh Testing Laboratory, Stevenson and Locust Sts., Pittsburgh 19, Pa., is a brochure which describes the testing and related services of this nation-wide professional testing laboratory. Profusely illustrated, the booklet covers the various activities under such heads as testing materials, field inspection and testing, product performance testing, and also gives some information on the equipment and facilities in the numerous branch laboratories of P.T.L. Copies of this 28-page booklet, page size $8\frac{1}{2}$ by 11 in., can be obtained from the Pittsburgh Testing Laboratory office in Pittsburgh, or from their branch offices located in many industrial centers in the country.

Catalogs and Literature Received

THE EMIL GREINER CO., 161 Sixth Ave., New York 13, N. Y. A two-page leaflet describing a small pump—the noiseless vertical centrifugal immersion pump. Illustrated.

BURRELL TECHNICAL SUPPLY CO., 1936-42 Fifth Ave., Pittsburgh 19, Pa. A 16-page folder—"The Burrell Technical Announcer of Scientific Equipment"—illustrated throughout. Describes various types of equipment—a demineralizer, thermoswitch, a ringmaker, rotator, stirrer, etc.

COLEMAN ELECTRIC CO., Maywood, Ill. A four-page leaflet describing Coleman Certified Buffer Tablets, the successor to liquid buffers. Illustrated.

RIEHLE TESTING MACHINES DIVISION OF AMERICAN MACHINE AND METALS, INC., East Moline, Ill. An eight-page folder, "Riehle Testing Machines—Instruments"—illustrated. Covers the Riehle Universal Precision Hydraulic Testing Machines for impact, tension, compression, transverse, hardness and other testing work.

LINDBERG ENGINEERING CO., 2450 West Hubbard St., Chicago, Ill. Bulletin 190, "Lindberg Controlled Atmospheres for Heat Treating." Describes and illustrates four distinct types of neutral heat-treating atmospheres, tells how they are produced, cost, and lists the applications for which each may be employed. Twelve pages.

Also, Bulletin 210, seven pages—"Lindberg Production Brazing Furnaces." Illustrates and describes in detail mesh belt conveyor continuous production brazing furnace, Lindberg roller hearth, and the term "Hydryzing."

PRECISION SCIENTIFIC CO., 1750 N. Springfield Ave., Chicago 47, Ill. Various bulletins describing equipment used in different tests covered in A.S.T.M. standards,—Rubber Aging Bath, D 471 and D 735; Flow Tester for Rubber and Plastics, D 530; Compression Set Tester for Rubber, D 395; Cold Box, D 797; and others. Illustrated.

New Technical Bulletin on Greases

THE Cooperative Committee of the Annular Bearing Engineers and the National Lubricating Grease Institute has recently published Technical Bulletin No. 6, "The Norma-Hoffmann Oxidation Test for Lubricating Greases—Significance of Test and Recommended Test Procedure."

This new Bulletin amplifies the information contained in the previous Bulletin No. 4, and itemizes the improved test apparatus and procedure, the scope and significance of the test, and the degree of reproducibility to be expected.

Copies of A.B.E.C.-N.L.G.I. Technical Bulletin No. 6 may be procured from National Lubricating Grease Institute, 164 Chandler Street, Buffalo 7, N. Y., at 50 cents each.

Personals . . .

. . News items concerning the activities of our members will be welcomed for inclusion in this column.

A most interesting article entitled "Meet Your New President... BRADLEY DEWEY" appeared in the February 10 *Chemical and Engineering News*. Mr. Dewey, the American Chemical Society president, has been a member of A.S.T.M. for a number of years. It is of interest to note that his father was for 56 years Professor of Economics and Statistics at Massachusetts Institute of Technology, and that his uncle is the noted philosopher and educator, John Dewey. His activities in World War I won him the Distinguished Service Medal, particularly for his work in connection with defense against gas. His firm, the Dewey and Almy Chemical Co., was established in 1919. Perhaps his most notable recent service involved the office of rubber director where he succeeded William Jeffers in carrying through the important responsibilities which this office entailed.

ARTHUR E. RAYMOND, of Santa Monica, Calif., Vice-President, Engineering, Douglas Aircraft Co., has been elected President of the Institute of Aeronautical Sciences, it has been announced. He succeeds Charles H. Colvin of New York, N. Y.

FRED L. WOLF, formerly Technical Director, Ohio Brass Co., Mansfield, Ohio, later in charge of Graphite Crucibles and Graphite Production, WPB, Washington, D. C., and Vice-President, Ross-Tacony Crucible Co., Philadelphia, who has just returned from a government-sponsored visit to Europe to study the non-ferrous metal situation there, has been appointed Technical Director, Non-Ferrous Ingot Metal Institute, Chicago, Ill.

ROY N. YOUNG, Assistant Vice-President and Operating Manager, Lehigh Portland Cement Co., Allentown, Pa., has been elected Vice-President and Operating Manager to succeed H. R. Hausman who has retired after 44 years of service with the company.

WALTER C. GRANVILLE, formerly Color Technologist, Interchemical Corp., Research Laboratories, New York, N. Y., is now in the Color Laboratories Division, Container Corporation of America, Chicago, Ill.

LT. COL. W. H. BASSETT, JR., is now at the Army Industrial College, Washington, D. C. He was Chief, Ammunition Branch, Army Service Forces, Springfield Ordnance District, Springfield, Mass.

CAPTAIN W. LEIGHTON COLLINS, who has been with the Ordnance Department, U. S. Army, Office of Strategic Services, Jackson Heights, L. I., N. Y., has returned to the Department of Theoretical and Applied Mechanics, University of Illinois, Urbana, Ill.

JAMES K. GIBSON has been released from the Navy after three years and seven months. He is now with Gladding, McBean and Co., Los Angeles, Calif.

A. C. WHITFORD, formerly Director of Research, S. Stroock and Co., Inc., Newburgh, N. Y., is now Fiber Technologist, Fort Myers, Fla. He is connected with Sea Island Mills, Inc., in New York City.

C. G. STEPHENS, formerly Quality Control Manager, The Glenn L. Martin Co., Baltimore, Md., is now Vice-President, The Gathmann Industrial Corp., Baltimore, Md.

HENRY O. ERB has severed his connections with the Coal Trade Association of Indiana, Terre Haute, Ind , as Director of Laboratory, and is now Coal Preparation Consultant, Terre Haute, Ind.

CROSBY MILLER has retired as Chief Engineer of The Chesapeake and Ohio Railway Co., his retirement having gone into effect the first of this year.

W. D. KERLIN is now Mechanical Engineer in Philadelphia. He was formerly Vice-President and Treasurer, Camden Forge Co., Camden, N. J.

HARLAN A. DEPEW, formerly Manager, Titanium Division, The Sherwin-Williams Co., Gloucester City, N. J., is now in the Research Department of The Flintkote Co., in Morristown, N. J.

H. W. SNYDER has retired as Works Manager of Lima Locomotive Works, Inc., Lima, Ohio.

I. J. FAIRCHILD retired as of the first of this year as Chief of the Division of Trade Standards, National Bureau of Standards, Washington, D. C. He is now Secretary of The Enameled Cast Iron Plumbing Fixtures Assn. and Vitreous China Plumbing Fixtures Assn., Washington, D. C.

STEPHEN W. BENEDICT has been discharged from the Armed Services and has returned to the National Bureau of Standards, Washington, D. C., as Materials Engineer.

EDWARD A. WILLIS has recently returned to employment in the Public Roads Administration as Senior Highway Engineer, Division of Physical Research after a special assignment with the War Department during the war period.

N. V. POLETIKA, formerly Senior Process Engineer, Curtiss-Wright Corp., Airplane Division, Buffalo, N. Y., is now a student studying for his doctorate at Yale University, School of Forestry, New Haven, Conn.

LLOYD M. MORRIS has returned from Army Service and resumed his duties in Materials Testing Engineering at The Pennsylvania Railroad Test Department in Altoona, Pa.

WALTER M. SCOTT has returned from the Service and is back at the Southern Regional Research Laboratory, New Orleans, La.

V. O. McCLURG, formerly, Chief Structural Engineer of Holabird & Root, architects, Chicago, Ill., is now connected with Mundie, Jensen & McClurg, Architects and Engineers, located in Chicago.

ROYALL D. BRADBURY, formerly Engineer-Director, Wire Reinforcement Institute, Washington, D. C., is now Highway Engineer, U. S. Public Roads Administration, Washington, D. C.

W. H. KLEIN is now Vice-President, Research and Development, Pennsylvania-Dixie Cement Corp., Nazareth, Pa. He was formerly Vice-President and General Operating Manager for this company.

FRED J. WALLS, President of the American Foundrymen's Association, and Manager of the Detroit office, International Nickel Co.'s Development and Research Division, recently received from the Detroit section of the A.F.A. a plaque and certificate of best wishes. The presentation was made on behalf of the Detroit chapter by FRANK G. STEINEBACH, Editor of *Foundry Magazine* and longtime active A.F.A. member.

M. L. CHANDROSS is now Merchandise Manager, Manhattan Shirt Co., New York, N. Y. He was formerly Technologist, War Production Board, Washington, D. C.

DANIEL RHEE is now President and General Manager of the Rheestone Thread Corp., Warren, R. I. He was formerly Technical Director of the Carr Manufacturing Corp., Bristol, R. I.

F. B. HORNIBROOK, formerly Materials Engineer, National Bureau of Standards, Washington, D. C., is now Assistant Director of Research, Master Builders Research Laboratories, Cleveland, Ohio.

C. A. H. KNAPP, who is now Foundry Engineer and Research Metallurgist, R. Lavin and Sons, Inc., Hamden, Conn., was formerly Director, Phelps Laboratories, Guilford, Conn.

E. B. T. KINDQUIST, formerly with Battelle Memorial Institute, Columbus, Ohio, is now with the Eastwood Nealley Corp., Belleville, N. J.

L. E. WELCH has severed connections with the Industrial Hard Chromium Co. of Newark, N. J., and is now a Plastics Engineer at East Orange, N. J.

R. W. BABB, who was connected with the U. S. Civil Aeronautics Administration in Seattle, Wash., is now with the Texas State Highway Department, Longview, Texas.

A. C. C. CHANG, formerly Design Engineer, Standard Oil Co. (Indiana), Whiting, Ind., is now Vice-President, General Engineering Co. of Shanghai, Shanghai, China.

J. J. KIRCHHOF is now Vice-President, Franklin Railway Supply Co., Inc., New York, N. Y. He was formerly Chief Engineer, Franklin Railway Supply Co., Inc., Baltimore, Md.

J. W. CHAMBERLIN, formerly Manager of Production, Cleaver-Brooks Co., Milwaukee, Wis., is now President, Appliance Corporation of America, Milwaukee, Wis.

R. DAVID THOMAS, JR., who was Director of Research and Engineering Arcos Corp., Philadelphia, Pa., is now Vice-President of the company.

LOUIS W. KEMPF, Assistant Director of Research, Aluminum Company of America, New Kensington, Pa., has been elected chairman of the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers.

E. K. SMITH, Metallurgical Consultant, Beverly Hills, Calif., who has been very active in A.S.T.M. work, particularly in the field of castings, and who was in the Far East on a Government mission, recently delivered a lecture to the Southern California Chapter of the American Foundrymen's Association held in Edison Auditorium on the subject "Specifications." In this lecture he made frequent reference to A.S.T.M. standards in this field.

In a recent issue of the *Magazine Digest* there is an article entitled "Mending the Holes in Knickerbocker's Pockets" describing some of the work of the New York City Testing Laboratory, a part of the Department of Purchase. Dr. W. L. Blackhall is director of the laboratory. The New York City Department of Purchase has two memberships in the Society—one in the Chief Engineering Division and the other in the Bureau of Standardization.

W. P. PUTNAM, a member of the Society since 1911, and President for many years of The Detroit Testing Laboratory, has announced the appointment to the Board of Directors of W. R. DeGowin, who was appointed General Manager. Mr. DeGowin has been affiliated with the laboratory staff since 1927, specializing particularly in metallurgical work.

H. J. KERR, for thirty-three years associated with The Babcock & Wilcox Co., retired as of December 31, 1945. For quite a period he was Service Engineer, concentrating on the subject of caustic embrittlement. Later he was in charge of research, development, and service and took an important part in the development of mercury boilers. He had been at Barberton since 1932 in charge of the research and development laboratory, and contributed a great deal to metallurgical advances. An early and persistant advocate of the use of silicon-killed steels, as all members of Committee A-1 on Steel will recall, he was much concerned with problems of graphitization. In a company announcement to his associates, President A. G. Pratt points out that "By his retirement the company suffers the loss of one who has contributed greatly to its success, and we who know him best have lost a fine companion." Mr. Kerr participated very actively in the work of a number of A.S.T.M. committees, particularly A-1 on Steel, and the Joint Committee on Effect of Temperature on the Properties of Metals. He is residing in Westfield, N. J.

O. U. COOK, for many years active in the work of the Society as representative of his company, the Tennessee Coal, Iron and Railroad Co., retired as of February 28, 1946. He was particularly active in the work of Committee A-1 on Steel serving on numerous subcommittees. He served one term as a member of the A.S.T.M. Executive Committee and for some time has been chairman of the General Technical Committee of the American Iron and Steel Institute.

L. G. WILSON, who was President of the Precision Thermometer and Instrument Co., Philadelphia, Pa., since the company was founded in 1910, has retired from active business and is being succeeded by CARL H. WASER, who has been elected President and Treasurer. Mr. Waser, a son of Carl Waser, who was active with Mr. Wilson in establishing the company, has been with Precision since 1928 and has for a number of years been Secretary and Treasurer. Before founding the company, Mr. Wilson was for many years associated with Queen and Co. in Philadelphia, a very famous early firm. Many of the leaders in the instrument industry were, in their earlier years, associated with Queen and Co., including Messrs. Leeds, Biddle, Patterson, the late A. H. Thomas, and others.

J. R. FRITZE, formerly Chief, Manufacturing Processes Section, U. S. Navy Department, Washington, D. C., is now Chief inspector and Salvage Manager, Chefford Master Manufacturing Co., Fairfield, Ill.

JULIUS AVINS is now Chemical Engineer, Wilkoff Chemical Co., N. Y. He was Engineer, General Chemical Co. Camden, N. J.

Several A.S.T.M. members were elected as officers of the American Concrete Institute at their recent annual meeting, as follows: *President:* H. F. GONNERMAN, Manager, Research Laboratory, Portland Cement Assn., Chicago, Ill.; *Vice-Presidents:* STANTON WALKER, Director of Engineering, National Sand and Gravel Association, Washington, D. C.; and ROBERT F. BLANKS, Engineering Control and Research, U. S. Bureau of Reclamation, Denver, Colo.; *Regional Directors:* FRANK H. JACKSON, Principal Engineer of Tests, Public Roads Administration, Federal Works Agency, Washington, D. C.; ALEXANDER FOSTER, JR., Vice-President, Warner Co., Philadelphia, Pa.; and HERBERT J. GILKEY, Head, Department of Theoretical and Applied Mechanics, Iowa State College, Ames, Iowa; and *Director-at-Large:* H. L. KENNEDY, Manager of Cement Division, Dewey & Almy Chemical Co., Cambridge, Mass.

FLOYD ROBERTS, formerly Standards Specialist, Office of Price Administration, Washington, D. C., has returned to State Laboratories Department, Bismarck, N. D., as Paint Chemist.

E. W. GASSAWAY has returned from active duty with the U. S. Army and is now General Manager, Franklin T. Gassaway and Sons in Sacramento, Calif.

FRED KELLAM, formerly Engineer of Bridges, State Highway Commission of Indiana, Indianapolis, Ind., is now Division Bridge Engineer, Public Roads Administration, Chicago, Ill.

J. FRED COLEMAN, who was Materials Engineer, Pennsylvania Department of Highways, Ardmore, Pa., is now District Field Engineer, The General Crushed Stone Co., Philadelphia, Pa.

FRANK T. SISCO, who has been serving for some time as Secretary of the Metals Divisions, American Institute of Mining and Metallurgical Engineers, New York, N. Y., during which time he served as Secretary of the Alloys of Iron Research, has relinquished his A.I.M.E. responsibilities and is again Director of the Alloys of Iron Research.

SIMON WILLIAMS, formerly Director of Research, National Cotton Council of America, Memphis, Tenn., is now Associate Director of Research, Fabric Research Laboratories, Inc., Boston, Mass.

ERNST LOEBELL, formerly Stress Analyst and Theoretical Design Engineer, Lead, Inc., Grand Rapids, Mich., is now Specification and Process Engineer, Gibson Refrigerator Co., Greenville, Mich.

WINSTON HUSSEY, formerly Technical Director, Byerlyte Corp., Cleveland, is now General Manager.

JOHN R. McDERMET, who was with the Elliott Co., Jeannette, Pa., as Assistant to President, is now Consulting Engineer in the Packard Building, Philadelphia, Pa.

The name of The Institution of Automobile Engineers, Research Department has been changed to Motor Industry Research Association with whom E. GIFFEN in Brentford, Middlesex, England, is associated.

D. R. CARSE, who was connected with the Climax Molybdenum Co., New York, N. Y., as Railroad Steel Representative, is now with the Pullman-Standard Car Manufacturing Co. in New York.

W. W. CULBERTSON, after having served approximately four and a half years in the Army Ordnance Department is now Associate Professor of Metallurgy at Case School of Applied Science, Cleveland, Ohio.

ERNEST W. DAVIS, Chief Electrical Engineer, Simplex Wire and Cable Co., Cambridge, Mass., was recently nominated for Vice-President of the North Eastern District of the American Institute of Electrical Engineers.

JOHN H. LONGBOTTOM, Director of Chemical Research, A. H. Wirz, Inc., Chester, Pa., was among a group of distinguished alumni presented with an Honorary Degree in Military Science by the Board of Trustees of the Pennsylvania Military College in January.

DR. JOSEPH J. MATTIELLO, Technical Director, Hilo Varnish Corp., Brooklyn, N. Y., was recently awarded the Meritorious Civilian Award for contributions to the Quartermaster Corps in the war effort by the War Department, Military Planning Division, Office of the Quartermaster General.

H. R. HAUSMAN, Vice-President and Assistant General Manager, Lehigh Portland Cement Co., Allentown, Pa., has retired after 44 years of service. He will be succeeded by Roy N. Young who has

been elected Vice-President and Operating Manager.

L. E. EKHOLM, formerly Metallurgical Engineer, Alan Wood Steel Co., Conshohocken, Pa., is now associated with Climax Molybdenum Co., New York, N. Y.

W. R. HIBBARD, JR., who has been active for three years in A.S.T.M. matters as a representative of the Materials and Specifications Section of the Bureau of Ships, Navy Department, Washington, D. C., is now released from the Navy and is at Yale University in New Haven in the Hammond Metallurgical Laboratory, as Associate Professor of Metallurgy.

JOHN DEN. MACOMB, Assistant to Vice-President, Inland Steel Co., Chicago, Ill., was nominated as a trustee for three years of the Western Society of Engineers and H. H. MORGAN, Vice-President and Chief Engineer, Robert W. Hunt Co., Chicago, was nominated a member of the Washington Award Commission, as reported by the Nominating Committee of the Western Society of Engineers to the Board of Direction meeting held February 27, 1946.

O. W. ELLIS, Director, Department of Engineering and Metallurgy, Ontario Research Foundation, Toronto, Canada, has been honored through receiving the degree of Doctor of Science from the University of Birmingham, England, this degree having been conferred (in absentia). Dr. Ellis received his bachelor's and master's degrees from Birmingham. He is active in A.S.T.M. work and is Vice-Chairman of the Western New York-Ontario District Committee.

W. P. EDDY, JR., formerly Materials Engineer, Pratt & Whitney Aircraft Division, United Aircraft Corp., East Hartford, Conn., has been appointed Chief of Engineering Operations. In addition to his former duties as materials engineer, Mr. Eddy takes charge of the inspection, experimental and administrative operations of the Engineering Department. He came to Pratt & Whitney in January, 1944, after fifteen years in the General Motors organization. Prior to coming to East Hartford, he was in charge of metallurgy, welding engineering and service engineering for the G.M. Truck and Coach Division. Mr. Eddy has been active in the work of the SAE and Aeronautical Materials Standards Groups. He has been Vice-Chairman of the SAE Iron and Steel Division.

Bureau of Standards Notes

The *Technical News Bulletin* of the National Bureau of Standards, since January of this year appearing in a new typographical style and size, notes a number of personnel changes at the Bureau. Dr. H. L. Dryden has been appointed Assistant Director, and his services will supplement those of E. C. Crittenden who continues as an Assistant Director. Dr. Dryden is also to continue as Chief of the Mechanics and Sound Division. Dr. H. T. Wensel, who for several years has been largely occupied with the administrative work of the Manhattan District, U. S. Army, Corps of Engineers, and has also served as acting chief of the Heat and Power Division, has been designated as Assistant to the Director to coordinate all Bureau activities relating to atomic energy. Dr. F. G. Brickwedde succeeds Dr. H. C. Dickinson as Chief of the Heat and Power Division, and another change involves the appointment of Dr. G. B. Schubauer as Chief of the Aerodynamics Section of the Mechanics and Sound Division, succeeding Dr. Dryden.

Another change in the Bureau setup is the consolidation with the Physical Chemistry Section, in the Chemistry Division, of the work on pH standards formerly headed by Dr. Acree who has retired, this work to be directed by Dr. E. R. Smith.

Necrology

(Dates of death are given where available)

M. C. BLEST, Engineering Assistant to President, Pressed Steel Car Co., Inc., Pittsburgh, Pa. (August 31, 1945.) A member of the Society since 1924, Mr. Blest who was the representative of his company membership in A.S.T.M., was active in the work of Committee A-1 on Steel, especially Subcommittees II on Structural Steel for Bridges, Buildings and Rolling Stock and XIX on Sheet Steel and Steel Sheets.

E. T. LONGSTRETH, President, Samuel H. French and Co., Philadelphia, Pa. (February 9, 1946.) Mr. Longstreth's membership in the Society dates from 1929. He was a member of Committee C-11 on Gypsum where he was active in the work of Subcommittee II on Gypsum Plasters.

J. F. CARLE, President, Southern Testing Laboratories, Inc., Birmingham, Ala. (December 16, 1945.) Representing the Southern Testing Laboratories' membership in the Society since 1936 when the Laboratories first became affiliated with A.S.T.M., Mr. Carle's activities in the Society included membership on Committee C-7 on Lime, C-12 on Mortars for Unit Masonry, and A-3 on Cast Iron where he was especially concerned in the work of Subcommittee XXI on Pressure Pipe.

KENNETH E. BURGESS, Director of Technical Research Magnetic Pigment Division, Columbian Carbon Co., Trenton, N. J. (February 10, 1946.) Mr. Burgess has represented the Columbian Carbon Co. (formerly Magnetic Pigment Co.) in the Society since 1934 when their membership first became effective. He was a member of Committee D-1 on Paint, Varnish, Lacquer, and Related Products where he served on Subcommittees VIII on Methods of Analysis of Paint Materials, XV on Specifications for Pigments, VII on Accelerated Tests for Protective Coatings, and II on Drying Oils.

FRANK F. FOWLE, Head, Frank F. Fowle and Co., Chicago, Ill. (January 21, 1946.) Member since 1924.

G. P. SULLIVAN, President, Independent Coal Tar Co., Boston, Mass. (November 25, 1945.) Member since 1928.

CHARLES URBACH, Associate in Pediatrics, Medical School, University of Pennsylvania; and Director of Laboratory for Vitamin Research, Children's Hospital of Philadelphia, Philadelphia, Pa. (February 23, 1946.) Member since 1941.

S. W. UTLEY, Vice-President and General Manager, Detroit Steel Casting Co., Detroit, Mich. (February 13, 1946.) Member since 1919.

CARROLL R. THOMPSON, Chief Engineer, Department of Wharves, Docks and Ferries, City of Philadelphia, Pa. (February 21, 1946.) Representative of Department membership since 1922.

Paper Covers Navy Department Work on Evaluating Rubbers

UNDOUBTEDLY many members will be interested in an article by T. A. Werkenthin, Navy Department, which is a comprehensive résumé of test methods developed in recent years in the Navy Department for evaluating natural and synthetic rubbers. Much of this work was under the direction of Mr. Werkenthin whose activities were concentrated in this field. This material, which includes a large number of illustrations, will appear in several issues of *Rubber Age*, beginning, we understand, with the March number. Editorial offices of *Rubber Age* are situated at 250 West 57th St., New York 19, N. Y.

INDEX TO ADVERTISERS

PROFESSIONAL CARDS

On this page are announcements by leading organizations and individuals of their services for testing, research, and consulting work.